Journal of Cardiovascular Disease Research

ISSN:0975-3583,0976-2833 VOL14, ISSUE02,2023

Original research article

Analysis of intraoperative findings and perinatal outcome of caesarean section in first stage of labor for Non-reassuring fetal status (NRFS) at a rural teaching hospital

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Abstract

Primary Caesarean section rates are on a rise in day to day obstetric practice. Non-Reassuring Fetal Status(NRFS) is a common indication for emergency Caesarean delivery (CD) in 1st stage of labor. The aim of this study was to evaluate NRFS cases in 1st stage of labor leading to emergency caesarean & analyze the association of NRFS with intra-operative findings, and perinatal outcome.

Methods: A retrospective observational study was conducted in the department of Obstetrics & Gynecology at PES Institute of Medical Sciences and Research, Kuppam. All necessary data were collected from 160 case records of pregnant women who underwent emergency caesarean in 1st stage of labor for NRFS, during the period July 2018 to June 2019. Cardiotocography (CTG) interpretation & NRFS categorization was done according to the FIGO consensus guidelines on intrapartum fetal monitoring CTG tracing classifications (2015). Statistical analysis was carried out by Chi-square test for qualitative variables to find the association & the level of significance was set at P value <0.05.

Results: In the NRFS pattern noted, total 53.12% (85) decelerations were seen. 22.5% (36) traces showed type 2 decelerations, 13.75% (22) were detected with prolonged deceleration, 16.87% (27) tracings had variable deceleration. Pathological baseline heart rate variations was significantly associated intra operative findings of MSAF (p<0.02). The presence of pathological CTG was associated with intraop liquor status & perinatal outcome (p value < 0.012). There were 34.38% NICU admissions out of 160 babies. 23.8% were admitted for observation, of which 18.3% babies showed Pathological CTG &28.1%babies showed suspicious intrapartum CTG. Statistically significant association was noted between gestational age and neonatal morbidity (p<0.001), predominantly birth asphyxia was prevalent at >40wks gestation. Birth asphyxia was noted in twelve babies (7.5%), of these 18.8% belonged to >40 wk gestation.

Conclusions: CTG plays an important role in diagnosing NRFS necessitating timely obstetric intervention. NRFS, in the presence of MSAF is associated with increased perinatal morbidity & mortality. Nevertheless, minimizing inter-observer variability during interpretation of NRFS, along with a good clinical judgement & timely intervention optimizes perinatal outcomes

Keywords:NRFS, FIGO2015, pathological CTG, caesarean delivery, MSAF, perinatal outcome

Introduction

Cardiotocography (CTG) plays a pivotal role in diagnosing Non-Reassuring Fetal Status (NRFS) in labor which is a leading cause of increasing primary Caesarean section rates. Most important concern of caesarean section apart from its possible surgical, anesthetic & medico legal implications is the increased repeat Caesarean section rate. NRFS was previously addressed as "Fetal Distress", which rather is a more ubiquitous term & is abandoned as per current recommendations from many experts and has been replaced by a novel term "Non-reassuring fetal status(NRFS)" to describe suspected fetal hypoxia [1, 2].

Fetal distress, which remains a most common indication for emergency caesarean section, may be associated with neonatal encephalopathy. However, as most neonates are found to be vigorous and healthy at birth despite being diagnosed as fetal distress, this generic term has poor predictive value for

ISSN:0975-3583,0976-2833 VOL14, ISSUE02,2023

perinatal outcomes and has hence been abandoned. NRFS can only be observed indirectly. The usual method of detection is electronic fetal heart rate monitoring wherein the data interpretation may be subject to high intra and inter-observer variability[1].

NRFS is not an adverse event by itself; rather it is an indicator of temporary or permanent oxygen deprivation to the fetus. This may lead to fetal hypoxia and metabolic acidosis. Fetal oxygenation is solely dependent on maternal oxygenation and placental perfusion. Disturbances in maternal oxygenation, uterine blood supply, and placental transfer of fetal gas transport may lead to fetal hypoxia and non-reassuring fetal status[1, 3]. Thus NRFS heralds presumed fetal jeopardy.

Maternal cardiovascular disease, anemia, diabetes, hypertension, infection, placental abruption, abnormal fetal presentation, pathological fetal growth restriction(PFGR) and umbilical cord compression, meconium stained amniotic fluid(MSAF) are the common maternal, obstetric and fetal conditions commonly associated with NRFS.

When oxygen levels in the fetal circulation decrease, the fetus undergoes deterioration in three stages: 1) Transient hypoxia without metabolic acidosis; 2) Tissue hypoxia with a risk of metabolic acidosis; 3) Hypoxia with metabolic acidosis[3].

The autonomous nervous system, mediated by parasympathetic and sympathetic systems regulates the fetal response to oxygen deprivation. In the initial stages, the fetus combats the transient hypoxia during labor by its compensatory mechanisms; however prolonged, uninterrupted fetal hypoxia leads to progressive acidosis with cell death, resulting in tissue damage, organ failure and potentially fetal demise[1].

Compensatory mechanisms in response to fetal hypoxia include 1) a decrease in heart rate; 2) a reduction in oxygen consumption secondary to cessation of nonessential functions such as gross body movements; 3) a redistribution of cardiac output to preferentially perfuse vital organs, such as the heart, brain, and adrenal glands; and 4) a switch to anaerobic cellular metabolism[1, 4].

Prolonged fetal hypoxia leads to significant perinatal morbidity and mortality. Of particular concern is short & long term complications *viz*. encephalopathy, seizures, cerebral palsy, and neurodevelopmental delay[5, 6]. Sustained oxygen deprivation markedly affects the fetal heart rate, thus making fetal heart rate monitoring a potentially valuable, commonly used and indispensable tool for assessing fetal oxygenation status in real time. NRFS patterns are observed in approximately 15% of labors[1, 7].Methods to diagnose NRFS during labor include intrapartum fetal heart monitoring, by intermittent fetal heart auscultations or continuous CTG tracing.[2] CTG (also known as electronic fetal monitoring EFM), records changes in the fetal heart rate and their temporal relationship to uterine contractions[8].It can detect suspected fetal hypoxia and/or acidemia as a result of inadequate fetal oxygenation[8]. EFM reduces hypoxia related deaths by 60% which translates into the prevention of 1 perinatal death per 1000 births at the expense of an increase in operative vaginal and CD for non-reassuring fetal status by a factor of 2-3.[9] The evidence of the benefits of continuous CTG monitoring, when compared with intermittent auscultation, in both low and high risk labors is scientifically inconclusive [8, 10]. Compared with intermittent auscultation, continuous CTG has shown to decrease the occurrence of neonatal seizures, however no effect has been demonstrated on the overall incidence of perinatal mortality or cerebral palsy[10].In spite of these limitations, continuous CTG monitoring should be considered in all situations where there is a high risk of fetal hypoxia/acidosis, such as maternal health conditions, PFGR, MSAF, epidural analgesia, abnormalities detected during intermittent fetal auscultation or the possibility of excessive uterine activity, as occurs with induced or augmented labor.

The routine use of admission CTG for low-risk women on entrance to the labor ward has been associated with an increase in caesarean delivery rates by approximately 20% and no improvement in perinatal outcomes. According to the Cochrane Review there is no role of admission CTG for women who are low risk on admission in labor. Women should be informed that admission CTG is likely associated with an increase in the incidence of caesarean section without evidence of benefit[11].

Guidelines from ACOG recommend against the routine use of electronic fetal monitoring(EFM) for low risk, healthy labors, with limited evidence of improved perinatal outcomes and its rising contribution to Caesarean Deliveries[12]. CTG monitoring is never a substitute for good clinical observation and judgement[10]. The objective of this study was to analyze the association of NRFS with Intraoperative findings & perinatal outcome.

The FIGO guidelines are the only guidelines with broad international consensus, and are simplified, with less emphasis on decelerations compared to the NICHD guidelines when evaluating CTG tracings. FIGO also provides recommendations for evaluating and categorizing fetal heart rate via intermittent auscultation, making these guidelines more useful for low resource settings.[1] FIGO consensus guidelines on intrapartum fetal monitoring CTG tracing classifications (2015) were used for interpretation of CTG trace & categorization to NRFS pattern in this study.

FIGO consensus guidelines on intrapartum fetal monitoring CTG tracing classifications 2015 [1]

FHRdesignation	Description

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Normal	Baseline heart rate: 110–160 bpmVariability: 5–25 bpmDecelerations: No repetitivedecelerations
Suspicious	Lacking at least one characteristic of normality, but with no pathologic features
Pathological	Baseline heart rate: <100 bpmVariability: Reduced variability for >15 min Increasedvariability for >30 minORSinusoidal pattern for >30 minDecelerations: Repetitive late orprolonged decelerations during >30 min or 20 min if reduced variabilityOROne prolonged deceleration with >5 min

Aim

To analyze the association of NRFS with intra-operative findings, APGAR score and perinatal outcome in 1st stage Caesarean performed for NRFS

Methods

This is a Retrospective Observational study conducted in the department of Obstetrics & Gynecology at PES Institute of Medical Sciences and Research. All necessary data from case records & CTG detected with NRFS belonging to pregnant women in labor admitted to labor room who underwent 1st stage caesarean during the period July 2018 to June 2019were collected from Medical Records Department using purposive sampling. Interpretation of CTG & categorization to NRFS pattern was done according to the FIGO consensus guidelines on intrapartum fetal monitoring CTG tracing classifications (2015) in this study.

Sample size calculation:

Formula

$$n = \frac{Z^2_{1-\alpha/2} * p(1-p)}{d^2}$$

Calculation

$$n = \frac{1.96^2 * 0.634(1-0.634)}{0.08^2} = 139$$

Inclusion Criteria

Pregnant women in labor with live singleton pregnancy with NRFS as the indication for cesarean delivery (CD) in the first stage of labor.

Exclusion criteria

a) NRFS as a co-indication for CD and second stage NRFS.
b) Pregnant women with previous Caesarean Section
c) Pregnant women with multiple Pregnancy
d) Pregnant women planned for elective caesarean section
e) Pregnant women with eclampsia, severe cardiac disease complicating pregnancy, Bad Obstetric History

Statistical analysis

SPSS(Statistical Package for Social Sciences)version 20. (IBM SPASS statistics [IBM corp. released 2011] was used to perform the statistical analysis. Data was entered in the excel spread sheet. Descriptive statistics of the explanatory and outcome variables were calculated by mean, standard deviation for quantitative variables, frequency and proportions for qualitative variables. Inferential statistics like Chi-square test was applied for qualitative variables to find the association. The level of significance is set at 5%

Results

The mean age distribution of the study participants was 23.09 ± 3.476 years.

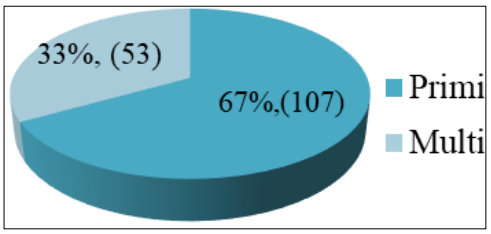

Fig 1: Distribution of the subjects based on parity

There were 89 cases with suspicious CTG, 7.86%(7) cases had FGR of which 5 had severe oligohydraminios and one patient had pre eclampsia. Two patients were unbooked cases with Rh isoimmunized pregnancies, 3 patients had gestational hypertension of which 1 patient had gestational HTN with Anemia, 1 patient GDM. On ARM, 4 cases of suspicious CTG tracing had thin meconium stained amniotic fluid.

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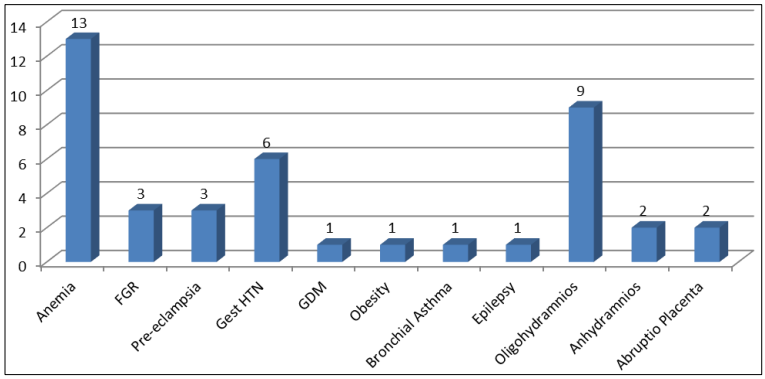

Fig 2: Risk Factors in Pathological CTG Group

Table 1: Cross-tabulation of the gestational age with neonatal morbidity and perinatal outcome

			GA-classified			Total	Chi-square value	p value
			< 37 wks	37 to 40 wks	> 40 wks			
Neonatal Morbidity	Asphyxia	Count	0	9	3	12	83.82	0.001*
		%	0.0%	6.3%	18.8%	7.5%		
	DIC	Count	1	0	0	1		
		%	50.0%	0.0%	0.0%	.6%		
	DIC, NEC	Count	0	1	0	1		
		%	0.0%	.7%	0.0%	.6%		
	HIE	Count	0	3	0	3		
		%	0.0%	2.1%	0.0%	1.9%		
	No morbidity	Count	1	122	13	136		
		%	50.0%	85.9%	81.3%	85.0%		
	RDS	Count	0	7	0	7		
		%	0.0%	4.9%	0.0%	4.4%		
Perinatal Outcome	Alive	Count	1	139	16	156	19.01	0.001*
		%	50.0%	97.9%	100.0%	97.5%		
	Expired	Count	1	3	0	4		
		%	50.0%	2.1%	0.0%	2.5%		

*significant, DIC:Disseminated Intravascular Coagulation, NEC;NecrotisingEnterocolitis, HIE:Hypoxic Ischaemic Encephalopathy, RDS:Respiratory Distress Syndrome

Statistically significant association was noted between gestational age and neonatal morbidity, predominantly birth asphyxia was prevalent at >40wks gestation. Birth asphyxia was noted in 12 babies (7.5%), 9(6.3%) of them were present in 37-40 gestation and 3(18.8%) were in more than 40 wk gestation. RDS was noted in 7 babies (4.9%) between 37 to 40wks. gestational age. There were 2 late pre term (>36wks) of which one baby developed DIC. 156 babies were alive, there were 4 neonatal deaths, 50% (1) which had blood stained liquor suggestive of abruption and presence of Retro placental clot intra operatively, belonged to GA <37wks. &2.1% (3) belonged to GA between 37 -40wks who had thick MSAF followed by MAS. There were no stillbirths reported. There was no significant association found between Induced labor and pathological CTG.

Table 2: Cross tabulation of intrapartum CTG and intra operative findings

Intra Operative findings			Intrapartum CTG		Total	Chi-square value	p value
			Suspicious CTG	Pathological CTG			
Intra op Liquor Status	Blood Stained	Count	1	3	4	2.96	0.39
		%	1.1%	4.2%	2.5%		
	Clear	Count	28	23	51		
		%	31.5%	32.4%	31.9%		
	MSAF	Count	60	45	105		
		%	67.4%	63.4%	65.6%		
Intra op Liquor quantity	Adequate	Count	50	36	86	2.33	0.31
		%	56.2%	50.7%	53.8%		
	Excess	Count	2	0	2		
		%	2.2%	0.0%	1.3%		
	Scanty	Count	37	35	72		
		%	41.6%	49.3%	45.0%		
Intra op Nuchal Cord loops	No loop	Count	83	61	144	2.51	0.28
		%	93.3%	85.9%	90.0%		

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	1 loop	Count	3	6	9		
		%	3.4%	8.5%	5.6%		
	2 loops	Count	3	4	7		
		%	3.4%	5.6%	4.4%		
Placenta & Membranes	Normal	Count	86	60	146	7.87	0.02*
		%	96.6%	84.5%	91.3%		
	Placenta& Cord Meconium stained	Count	1	7	8		
		%	1.1%	9.9%	5.0%		
	RetroPlacental clot	Count	2	4	6		
		%	2.2%	5.6%	3.8%		

*significant

There was a significant association noted between pathological CTG and presence of retroplacental clot & Meconium staining of placenta, membranes & cord (p value <0.02).

Table 3: Cross tabulation of patho baseline HR and intra operative findings

Intra Operative findings				Patho Baseline HR		Total	Chi-square value	p value
			Normal Baseline HR	Bradycardia	Tachycardia			
Intra op Liquor Status	Blood stained	Count	2	2	0	4	15.04	0.02*
		%	1.8%	15.4%	0.0%	2.5%		
	Clear	Count	35	7	9	51		
		%	30.7%	53.8%	27.3%	31.9%		
	MSAF	Count	77	4	24	105		
		%	67.6%	30.8%	72.7%	65.6%		
Intra op Liquor quantity	A	Count	57	7	22	86	3.39	0.49
		%	50.0%	53.8%	66.7%	53.8%		
	E	Count	2	0	0	2		
		%	1.8%	0.0%	0.0%	1.3%		
	S	Count	55	6	11	72		
		%	48.2%	46.2%	33.3%	45.0%		
Intra op Nuchal Cord loops	0	Count	103	11	30	144	6.55	0.16
		%	90.4%	84.6%	90.9%	90.0%		
	1	Count	6	0	3	9		
		%	5.3%	0.0%	9.1%	5.6%		
	2	Count	5	2	0	7		
		%	4.4%	15.4%	0.0%	4.4%		
Placenta PCM	Normal	Count	106	11	29	146	7.1	0.13
		%	93.0%	84.6%	87.9%	91.3%		
	PCM	Count	5	0	3	8		
		%	4.4%	0.0%	9.1%	5.0%		
	RP clot	Count	3	2	1	6		
		%	2.6%	15.4%	3.0%	3.8%		

*significant

Statistically significant association was noted between pathological baseline heart rate variations and intra operative findings of MSAF(p<0.02) in our study. In NRFS pattern, total decelerations were 53.12% (85). 22.5% (36) traces showed type 2 decelerations, 13.75% (22) were detected with prolonged deceleration, 16.87% (27) tracings had variable deceleration. There was no association found between pathological beat to beat variability, type 2 decelerations, prolonged decelerations and intra operative findings of liquor status, color, quantity, nuchal cord.

Table 4: Cross tabulation of pathological CTG and APGAR scores

APGAR Scores			Pathological CTG		Total	Chi-square value	p value
			0	1			
APGAR at 1 min	< 3	Count	2	1	3	4.08	0.12
		%	2.2%	1.4%	1.9%		
	3 to 6	Count	19	7	26		
		%	21.3%	9.9%	16.3%		
	7 to 8	Count	68	63	131		
		%	76.4%	88.7%	81.9%		
APGAR at 5 min	< 3	Count	1	0	1	2.65	0.44
		%	1.1%	0.0%	.6%		
	> 8	Count	52	49	101		
		%	58.4%	69.0%	63.1%		
	3 to 6	Count	5	4	9		

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		%	5.6%	5.6%	5.6%		
	6 to 8	Count	31	18	49		
		%	34.8%	25.4%	30.6%		

No statistically significant association was found between pathological CTG trace and neonatal APGARscore at 1" &5"

Of the 160 neonates, 2 developed DIC of which 1 baby had associated NEC and the detection to delivery interval was 110 min. in this baby. 3 babies developed HIE where the mean detection to delivery interval was 98.33± 97.57min. In 12 babies, birth asphyxia was noted where the mean detection to delivery interval was 34.42±16.27 min.136 babies had no neonatal morbidity who delivered within average time of 48.24±33.8min of detection of Pathological CTG.

There were 34.38% (55) NICU admissions out of 160 babies. Of these 23.8% (38) were admitted for observation, of which 18.3%(13) babies showed Pathological CTG &28.1%(25) babies showed suspicious intrapartum CTG. 12 babies were intubated, out of which 7.9% (7) babies with suspicious CTG and 7% (5) babies with pathological CTG required intubation. 3 babies were put on CPAP of which 2.2% (2) with suspicious intrapartum CTG 1.4% (1) showed pathological CTG.

Table 5: Cross tabulation of intra op liquor status with neonatal morbidity

Intrapartum CTG	Neonatal Morbidity		Intra op Liquor Status			Total	Chi-square value	p value
			Blood Stained	Clear	MSAF			
Suspicious CTG	Asphyxia	Count	0	1	7	8	22.61	0.004*
		%	0.0%	3.6%	11.7%	9.0%		
	DIC,NEC	Count	0	0	1	1		
		%	0.0%	0.0%	1.7%	1.1%		
	HIE	Count	0	0	2	2		
		%	0.0%	0.0%	3.3%	2.2%		
	No morbidity	Count	0	24	49	73		
		%	0.0%	85.7%	81.7%	82.0%		
	RDS	Count	1	3	1	5		
		%	100.0%	10.7%	1.7%	5.6%		
	Total	Count	1	28	60	89		
		%	100.0%	100.0%	100.0%	100.0%		
Pathological CTG	Asphyxia	Count	0	0	4	4	27.57	0.006*
		%	0.0%	0.0%	9.1%	5.6%		
	DIC	Count	1	0	0	1		
		%	33.3%	0.0%	0.0%	1.4%		
	HIE	Count	0	0	1	1		
		%	0.0%	0.0%	2.3%	1.4%		
	No morbidity	Count	2	23	38	63		
		%	66.7%	100.0%	84.1%	88.7%		
	RDS	Count	0	0	2	2		
		%	0.0%	0.0%	4.5%	2.8%		
	Total	Count	3	23	45	71		
		%	100.0%	100.0%	100.0%	100.0%		

*significant

11.7%(7) cases of suspicious CTG with intra operative -finding of MSAF were detected with birth asphyxia, 3.3%(2) babies developed HIE. 82%(73) babies with Suspicious CTG findings, developed no neonatal morbidity, of which 81.7%(49) babies with MSAF &85.7%(24)babies with Intra operative clear liquor had no neonatal morbidity. Significant statistical association was observed in cases with suspicious CTG & intra operative liquor status & neonatal morbidity (p value <0.004).

Out of a total 45 cases of intra operative MSAF and intrapartum pathological CTG,9.1%(4) babies were diagnosed withbirth asphyxia, 4.5%(2) babies developed RDS and 2.3% (1) HIE while 84.1%(38) babies showed no neonatal morbidity.

Cases with pathological CTG showed Significant statistical association with intraoperative liquor status & neonatal morbidity (p value <0.006). In both suspicious CTG (p<0.004) and pathological CTG (p<0.006), out of total 12 babies who developed birth asphyxia there was significant association with presence of MSAF intraoperatively. 11.7%(7) babies with suspicious CTG and 9.1%(4) babies with pathological CTG had MSAF and 3.6%(1) baby showing intrapartum suspicious CTG had clear liquor but developed birth asphyxia.

Table 6: Cross tabulation of intra op liquor status with perinatal outcome

CTG	Perinatal Outcome		Intra op Liquor Status			Total	Chi-square value	p value
			Blood Stained	Clear	MSAF			
Suspicious	Alive	Count	1	28	58	87	0.98	0.61

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		%	100.0%	100.0%	96.7%	97.8%		
	Neonatal death	Count	0	0	2	2		
		%	0.0%	0.0%	3.3%	2.2%		
	Total	Count	1	28	60	89		
		%	100.0%	100.0%	100.0%	100.0%		
Pathological	Alive	Count	2	23	44	69	10.94	0.012*
		%	66.7%	100.0%	97.7%	97.2%		
	Neonatal death	Count	1	0	1	2		
		%	33.3%	0.0%	2.3%	2.8%		
	Total	Count	3	23	45	71		
		%	100.0%	100.0%	100.0%	100.0%		

*significant

Strong association was noted between Pathological CTG, Intraop liquor status & Perinatal outcome (p value < 0.012)

Discussion

Role of CTG has popularly emerged as a novel, non-invasive tool to monitor fetal wellbeing, detect non-reassuring fetal status and assist obstetricians in prompt decision making on the mode of delivery to improve perinatal outcome. In this study, intrapartum CTG in high risk women was done for 30 minutes in left lateral position and labeled as normal, suspicious or pathological. Suspicious pattern CTG was repeated after targeted intrauterine fetal resuscitation measures such as maternal oxygen administration, amnioinfusion, intravenous fluid bolus, discontinuation of oxytocin, and tocolytic administration, depending on the etiology. The goal of intrauterine resuscitation was to prevent or reverse fetal hypoxia. Mode of delivery for NRFS detected in 1st stage of labor was Caesarean section. Statistically significant association was noted between gestational age and neonatal morbidity in our study, predominantly birth asphyxia which was prevalent at >40wks gestation. Birth asphyxia was in 18.8% (3)in more than 40 wk gestation. This can attributed to associated risk factors *viz* oligohydraminios, FGR, pre-eclampsia seen in these cases.RDS was noted in 4.9% (7) babies between 37 to 40wks of gestation which was not statistically significant. There were 2 late pre term (>36wks) of which one baby developed DIC

In our study there were 60 cases of >40wks gestational age, 58.33% (35) of them had pathological CTG tracings. In a study by Hairong *et al*.[13] they observed that gestational age > 40wks had a significant statistical association (p<0.05) with pathological CTG. In our study, 156 babies were alive, there were 4 neonatal deaths. 50%(1) with pathological CTG with associated blood stained liquor and presence of retro placental clot intra operatively suggestive of abruption, belonged to GA <37wks which was statistically significant(p<0.001) & 2.1%(3) belonged to GA between 37-40wks who had thick MSAF, of these 3.3%(2) had suspicious CTG, 2.3%(1) had pathological CTG. Our study showed a strong association between pathological CTG, intraop liquor status & perinatal outcome (p value < 0.012). There were no stillbirths reported in our study. In study by Bindu VK *et al*. [9]ICU admission for MSAF with normal CTG, MSAF with abnormal CTG & clear liquor with abnormal CTG were 17.2%, 39.9% & 33.3% respectively. They reported 28 neonatal deaths among 600 babies. In our study there was no significant association found between spontaneous or induced labor and pathological CTG thereby suggesting that risk factors associated with pregnancy may have played a role leading to abnormal CTG tracing. In our study a total of 8 patients had intra operative findings of placenta, membranes and cord stained with meconium out of which9.9%(7) patients had pathological CTG and 1.1%(1) patient had suspicious CTG.Intra operative findings: presence of retroplacental clot denoting abruption was seen in 5.6%(4) patients with pathological CTG and in 2.2%(2) patients with suspicious CTG. There was a significant association noted between pathological CTG and presence of retroplacental clot & Meconium staining of placenta, membranes & cord (p value <0.02). No statistically significant association was noted between the intra operative findings of liquor quantity or presence of nuchal cord with pathogical CTG. In our study 105 patients showed MSAF among whom 67.6%(77) had normal baseline heart rate on CTG and 60.87%(28) patients had pathological baseline heart rate. Among the pathological baseline heart rate, the predominant pattern was fetal tachycardia seen in 72.7%(24) with MSAF and 27.3%(9) with clear liquor.Statistically significant association was noted between pathological baseline heart rate variations and intra operative findings of MSAF(p<0.02) in our study. Of the NRFS pattern noted, total decelerations were seen 53.12%(85) CTG tracings. 22.5%(36) traces showed type 2 decelerations, 13.75%(22) were detected with prolonged deceleration, 16.87%(27) tracings had variable deceleration. There was no association found between pathological beat to beat variability, type 2 decelerations, prolonged decelerations and intra operative findings of liquor status, color, quantity, nuchal cord. In Bindu VK *et al*. [9]total number of decelerations was seen in 38% cases as against 53.12% seen in our study. Of the 36 pathological type 2 deceleration tracings,75%(27) were associated with MSAF(p value 0.17) while intra operative finding of scanty liquor quantity was noted in 47.2%(17). However it was not statistically significant, mostly due to smaller sample size of our study.

Of 22 cases of pathological prolonged deceleration on CTG tracing we noticed 68.2%(15) had associated

ISSN:0975-3583,0976-2833 VOL14, ISSUE02,2023

MSAF and 31.8%(7) had scanty liquor quantity intra operatively. However this too was not statistically significant owing to the smaller sample size. In our study, neonatal APGAR score at 1" was 7-8 in 88.7%(63) among the pathological CTG group & 76.4%(68) in suspicious CTG group. APGAR score of 3-6 was seen in 9.9%(7) in pathological group and 21.3%(19) with suspicious CTG comparable to Bhatia *et al*. [9] In study by Banu *et al*. [14] statistically significant association was noted in both 1" &5 " APGAR score among suspicious and pathological CTG traces. Hairong *et al*. [13]observed 5" APGARscore of < 7 in 2.4%(23) in suspicious CTG and 5%(11) in pathological traces as against 34.8%(31) and 25.4%(18) of 5" APGAR score 6-8 in our study. The discrepancy noted in our study is attributable to the early decision to expedite delivery by caesarean section which may have contributed to better APGAR scores at 1"& 5". In our study, prolonged detection to delivery interval was associated with grave neonatal morbidity such as HIE & DIC with NEC. This could be probably attributed to associated risk factors in the study subjects. Also observer variability in interpretation of CTG tracing leading to delayed decision making may have contributed to neonatal morbidity in our study. In our study MSAF in the presence of NRFS either suspicious or pathological CTG pattern, resulted in increase in perinatal morbidity. Similar results were seen in studies by Bindu VK *et al*.[9]Hairong *et al*. [13]. Hairong *et al*. [13]demonstrated that risk of perinatal mortality and neonatal morbidity was significantly increased in infants in presence of moderately abnormal CTG tracing comparable to our study which gave similar results. In our study we noted that though suspicious CTG was associated with MSAF in 81.7%(49) cases, there was no neonatal morbidity in these cases. We attribute it to the prompt intervention and early decision making for caesarean delivery, thereby reducing our perinatal morbidity rates. This is comparable to a study by Bhatia *et al*. In their study MSAF in presence of Normal CTG were taken as NRFS cases and taken for caesarean delivery. Gaur *et al*. [15]found strong association of pathological CTG with poorer perinatal outcome in patients with associated risk factors similar to our study.

Limitations

The primary indication of NRFS cases in 1st stage of labor taken for emergency caesarean was selected for our study analysis. However, combinations of NRFS and maternal indications for delivery may have co-existed and affected the differences in outcome in our study. So, if NRFS was assigned as an indication for operative delivery as per the case record, it was selected as the primary indication in data collected from MRD. Our sample size was insufficient to detect the association of NRFS with rare events such as HIE, DIC, NEC or neonatal death. Most deliveries for NRFS are not associated with acidemia & Fetal Scalp Blood Sampling (FBS) would help detect fetal acidosis. Since invasive FBS was not done in our study we could not come to a definite consensus on this association. Moreover, the inter-observer variation in interpretation of abnormal CTG readings and recommendations for early interventions may have affected the results.

Conclusion

Cardiotocography has emerged as a simple, non-invasive and effective tool for early prediction of presumed fetal hypoxia in high risk pregnancy. Considering the rise of unnecessary caesarean sections, precise clinical history with good clinical judgement, comprehensive interpretation of CTG tracings is mandatory to diagnose the underlying cause of NRFS so as to assess the reversibility of the associated conditions and timely intervention in order to avoid prolonged fetal hypoxia/acidosis which will aid to improve perinatal outcomes. To summarize, the presence of non-reassuring fetal heart rate patterns with MSAF are associated with increased perinatal morbidity & mortality. Minimal inter-observer variability while interpreting NRFS, is desirable to reduce caesarean rates. The small sample size of this study may have derived inconclusive evidence on association of pathological type 2 & prolonged decelerations with scanty intraop liquor quantity. Further multivariate regression analytic studies need to be done on a larger sample size to derive conclusive reports. Need for a cost-effective, non-invasive, user friendly, universally available & acceptable method complementary to CTG would be helpful for a judicious decision making.

Institutional Ethical approval was obtained for this study.

Funding: None

Conflict of Interest: None

ISSN:0975-3583,0976-2833 VOL14, ISSUE02,2023

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