Impact of Intrapartum Cardiotocographic Monitoring on Neonatal Outcome in High Risk Pregnancies

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ABSTRACT

BACKGROUND

Intrapartum cardiotocography (CTG) is a test which is used to monitor the foetal heart rate and maternal uterine contractions that can be recorded electronically on a paper trace. The basic principle of intrapartum foetal monitoring is to identify the developing foetal hypoxia in order to prevent subsequent acidaemia and cell damage. The objective of this study is to evaluate the CTG findings in high risk obstetric cases and study the association between abnormal CTG findings with neonatal outcome.

METHODS

A prospective hospital based study was conducted in 256 high risk pregnant women fulfilling the eligibility criteria, who were admitted in the Department of Obstetrics and Gynaecology, VSSIMSAR, Burla, over a period of 2 years from November 2017 to October 2019. CTG monitoring was done for the study population and trace was interpreted. Parameters like mode of delivery, colour of liquor, APGAR score, and Neonatal Intensive Care Unit (NICU) admission were noted and recorded.

RESULTS

In our study population, normal CTG pattern was observed in 68% while suspicious and pathological pattern was observed in 22.6% and 9.4% pregnancies respectively. Incidence of meconium stained liquor was significantly more among patients with suspicious (67.2%) and pathological (87.5%) traces compared with normal (19%) traces. 10.9% of normal trace, 62.1% of suspicious and 83.3% of pathological trace groups were delivered by Lower Segment Caesarean Section (LSCS). Association of suspicious and pathological pattern in CTG and NICU admission was found to be statistically significant ($p< 0.001$).

CONCLUSIONS

Intrapartum CTG monitoring can be used as an important non-invasive tool to diagnose foetal compromise during the course of labour and can help in better management of high risk obstetric patients, thus reducing neonatal mortality.

KEYWORDS

Intrapartum Cardiotocography, High Risk Pregnancy, Neonatal Outcome

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BACKGROUND

The process of birth is a hazardous journey and labour forms the most critical part of the journey. Foetal surveillance during labour is important to ensure the delivery of a healthy baby in good condition with minimum intervention. Although, majority of foetuses cope well during labour, the journey through the birth canal is stressful and the foetus may mount a "stress response."[1] Foetuses with utero-placental insufficiency develop hypoxia in labour that may be acute or sub-acute. The main aim of monitoring a foetus in labour is to detect changes in foetal heart rate (FHR) that suggest a possibility of foetal hypoxia and metabolic acidosis so that timely action can be taken to prevent adverse outcome. Such an approach is introduced to prevent neurological injury, including cerebral palsy.[2] For this purpose, electronic foetal monitoring (EFM) has widely been adopted.[3] Various methods have been used to assess intrapartum foetal distress. Currently the two standard methods intermittent auscultation and EFM by cardiotocograph (CTG) are used. Intermittent auscultation is simple and as safe as continuous EFM.[4] Although with intermittent auscultation the baseline foetal heart rate (FHR) can be measured, other features of the foetal heart such as baseline variability, accelerations and decelerations are difficult to quantify.[5] EFM is a non-invasive method and provides better information about baseline variability and is a visual sensitive record. As a consequence some authors attribute a considerable decrease in the overall perinatal mortality to the use of CTG and today CTG is the first line investigation for ante and intrapartum foetal assessment.[6] Routine and continuous electronic monitoring of intrapartum FHR in high risk pregnancies has become an established obstetric practice in industrialized countries.[1] However, routine and continuous monitoring cannot be done in many developing parts of the world due to economic constraints. Therefore selection of patients for continuous monitoring becomes necessary in labour wards with few monitors. Continuous CTG is generally recommended for pregnant mothers who are considered as being at risk of increased perinatal morbidity and mortality. Certain risk factors are being identified as indicators for continuous CTG monitoring in labour.[7] The basic principle of intrapartum foetal monitoring is to identify the developing foetal hypoxia in order to prevent subsequent acidaemia and cell damage. The main justification of CTG is that the uterine contractions of labour put stress on the placental circulation; an abnormal tracing indicates a deficiency and hence identifies foetal compromise at an early enough stage to allow intervention.[7,8] This study evaluates the impact of Intrapartum CTG monitoring on neonatal outcome in high risk obstetric patients in our setup and the objectives are-

1. To find out the CTG findings in high risk obstetric cases.
2. To find out the association between abnormal CTG findings with neonatal outcome on the basis of Mode of delivery, Colour of liquor, APGAR score, NICU admission.

METHODS

A prospective hospital based study was conducted in 256 high risk pregnant women fulfilling the eligibility criteria, who were admitted in the Department of Obstetrics and Gynaecology, VSSIMSAR, Burma, over a period of 2 years from November 2017 to October 2019. Inclusion criteria were high risk obstetric patients with one or more of the following risk factors like Pre-eclampsia, Postdatism, Premature rupture of membranes >6 hours, History of recurrent pregnancy loss, Previous history of stillbirth, Oligohydramnios/Polyhydramnios, Intrauterine growth retardation (IUGR), Diminished foetal movement, Rh –ve pregnancy and Pregnancy with concurrent medical illness (i.e. Sickle cell disease, Hypertension, Diabetes mellitus, Thrombophilia, Renal disease, Antiphospholipid syndrome, SLE).

Preterm labour**,** major congenital anomaly of the foetus detected by the antenatal ultrasound scan. Acute obstetric emergencies which need immediate delivery or intervention (i.e. massive abruption, cord prolapsed, uterine rupture)**,** Multiple pregnancy**,** Malpresentations**,** Patients planned for elective LSCS were excluded from the study.

Patients described about the procedure they have to undergo after a preliminary history taking, thorough general examination and Obstetric examination. Informed consent was taken. CTG monitoring using BPL Foetal Monitor FM9853, standardized at speed of 1 cm/min was done for minimum of 20 minutes during active labour. External abdominal transducers were used for CTG; the one for the FHR tracing was placed on the maternal abdomen where the FHS were best heard and the one for noting the uterine pressure was positioned on the fundus of the uterus after applying Aquasonic gel. The results were studied according to NICE guidelines & CTG tracings were categorized as 'Normal', 'Suspicious' & 'Pathological'.

- Patients with normal CTG were monitored with intermittent auscultation for 1 minute, every 30 minutes in stage I and every 5 minutes in stage II. Any abnormal auscultation pattern in foetal heart sounds were subjected to continuous monitoring.
- Suspicious CTG findings were subjected to continuous monitoring and managed accordingly.
- Pathological CTG findings were taken as foetal distress and delivery was hastened by instrumentation or operative method depending on cervical dilatation and station of foetal head.

The progress of labour was monitored and labour outcome was assessed with respect to, Mode of delivery, Colour of liquor, APGAR score, NICU admission.

RESULTS

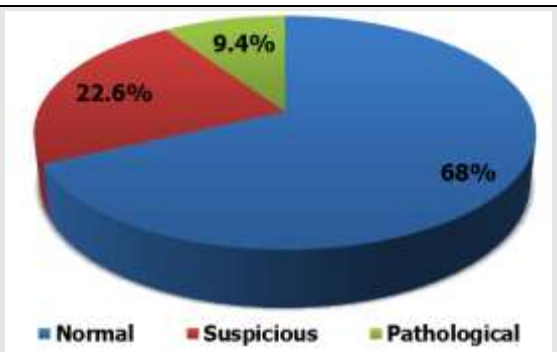
Total 256 patients were studied. Most of the females were between 20-30 years of age (87.1%), while only 6.6% were

below 20 years of age and 6.3% were above 30 years of age. Most women were primigravida (61.7%) while 23.8%, 9.4% and 3.9% were 2nd, 3rd and 4th gravida respectively. Only 1.2% were greater than 4th gravida.

Risk Factors	No. of Cases	%
Postdated	111	43.4%
PIH	53	20.7%
Oligohydramnios	35	13.7%
PROM	30	11.7%
DFM	22	8.6%
Previous history of stillbirth	17	6.6%
IUGR	11	4.3%
RPL	9	3.5%
SCD	9	3.5%
Rh –ve pregnancy	6	2.3%
Polyhydramnios	2	0.8%

Table 1. Distribution of Cases Based on Risk Factors

As evident from table-1, Postdatism was the most common risk factor present in 43.4% women, followed by PIH (20.7%), Oligohydramnios (18.1%), PROM (11.7%) and Decreased foetal movement (8.6%). A few patients had multiple risk factors (19.1%) and remaining 80.9% had single risk factor.



Graph 1. CTG Interpretation

Among the study group of 256 cases, Normal CTG pattern was observed in 174 cases, while suspicious and pathological pattern was observed in 58 and 24 cases respectively.

CTG Trace	Vaginal	Instrumental	LSCS
Normal (174)	155 (89.1%)	0 (0%)	19 (10.9%)
Suspicious (58)	16 (27.6%)	6 (10.3%)	36 (62.1%)
Pathological (24)	0 (0%)	4 (16.7%)	20 (83.3%)
Total (256)	171 (66.8%)	10 (3.9%)	75 (29.3%)

Table 2. CTG and Mode of Delivery

Most of the patients (66.8%) had spontaneous vaginal delivery while 29.3% patients underwent LSCS and 3.9% had instrumental delivery. Vaginal delivery was common in normal CTG trace as compared to operative delivery, which was common in suspicious or pathological CTG. And most of the patients with normal CTG who underwent LSCS were for indications other than foetal distress like non progress of labour, CPD etc., Among 174 normal CTG trace 155 delivered vaginally and 19 cases were delivered by caesarean section (16 patients for NPOL and 3 patients for CPD) and none by instrumental delivery.

In suspicious group (58 patients), 16 had vaginal delivery, 6 had instrumental delivery and 36 delivered by LSCS indication being foetal distress. Out of the 24 patients with pathological CTG trace 4 had instrumental delivery and 20 underwent emergency LSCS for foetal distress. p value <0.001, which suggests that the values are highly significant.

Perinatal Outcome		Normal (n=174)	Suspicious (n=58)	Pathological (n=24)	P Value
Liquor	Clear	141 (81%)	19 (32.8%)	3 (12.5%)	<0.
	MSL	33 (19%)	39 (67.2%)	21 (87.5%)	001
APGAR at 5 mins	>7	172 (98.8%)	36 (62.1%)	5 (20.8%)	<0.001
	<7	2 (1.2%)	22 (37.9%)	19 (79.2%)	
NICU admission	No	172 (98.8%)	25 (43.1%)	4 (16.7%)	<0.001
	Yes	2 (1.2%)	33 (56.9%)	20 (83.3%)	

Table 3. Correlation of CTG with Perinatal Outcomes

Out of 174 patients with normal CTG trace, 81% had clear liquor and 19% patients had meconium stained. In suspicious group, 32.8% patients had clear liquor while 67.2% patients had meconium stained amniotic fluid. In the pathological group, only 12.5% patients had clear liquor while 87.5% patients had meconium liquor. P value < 0.001 suggests highly significant association of the values obtained in this study. Most of the babies born to mothers with normal CTG had good Apgar score at 5 minutes compared to babies born to mothers with suspicious and pathological CTG. Among normal CTG trace, 172 (98.8%) babies had APGAR score >7 at 5 minute and only 2 (1.2%) babies had APGAR score <7 at 5 minutes. Among suspicious CTG tracing, 36 (62.1%) babies had APGAR score >7 at 5 minute while 22 (37.9%) babies had APGAR score <7 at 5 minute. Among pathological CTG trace, 19 (79.2%) babies had APGAR score <7 at 5 minute while only 5 (20.8%) babies had APGAR score >7 at 5 minute. The p value <0.001 suggests highly significant association between the CTG findings and 5 minute APGAR score in this study. Among the 256 patients 78.5% babies did not require NICU admission mostly belong to normal CTG trace (98.8%) and among the babies who needed NICU admission were mostly born to mothers with suspicious (56.9%) and pathological CTG trace (83.3%). P value <0.001 suggests highly significant association between the CTG tracing and NICU admission in our study.

Table 3 Shows incidence of birth asphyxia was greater in the pathological and suspicious group when the babies were assessed by Apgar score <7 at 5 minute and NICU admission. There was one neonatal death due to birth asphyxia in one baby born to mother with pathological CTG.

Outcome	5 Min APGAR	NICU Admission
Sensitivity	95.4%	96.4%
Specificity	80.8%	85.6%
PPV	50%	64.6%
NPV	98.9%	98.9%
Diagnostic Accuracy	83.2%	87.9%

Table 4. Sensitivity, Specificity, PPV and NPV of CTG for Neonatal Outcome

The above table depicts the diagnostic utility of cardiotocography in labour to predict neonatal outcome Sensitivity and specificity of CTG towards 5 minute Apgar was 95.4% and 80.8% respectively while Positive predictive value and Negative predictive value was 50% and 98.9% respectively. Sensitivity and specificity of CTG towards NICU

admission was 96.4% and 85.6% while Positive predictive value and negative predictive value was 64.6% and 98.9% respectively. As seen in table-4, specificity i.e., ability to identify correctly those who are not at risk for foetal distress (i.e., true negative) and sensitivity i.e., ability to detect correctly true positives are high. The negative predictive value of CTG in predicting foetal wellbeing is very high though its positive predictive value is not so good. The overall diagnostic accuracy of CTG for 5 minute APGAR and NICU admission was found to be high (83.2% for 5 minute APGAR and 87.9% for NICU admission).

DISCUSSION

Labour is a stressful process and changes observed in the CTG trace may reflect foetal response to the ongoing hypoxic or mechanical stress during labour such as compression of the umbilical cord or reduction in the placental blood flow. Continuous foetal monitoring is mandatory in any foetus considered to be at 'high risk' of sustaining intrapartum hypoxic injury. EFM can detect foetal hypoxia early so that unnecessary delay in intervention can be avoided. In our study, out of 256 most of the females were between 20-30 years of age (87.1%), while only 6.3% were above 30 years of age. Majority of patients were primigravida (61.7%) while 23.8%, 9.4%, 3.9% and 1.4% patients were 2nd, 3rd, 4th and greater than 4th gravida respectively. Similar study by Rahman et al.[1] majority of women were in 21-30 years age group (73.8%). 61.9% women were primigravida while 38.1% were multigravida. In study by Joshi H et al.[9], majority of patients were primigravida (67%) while 23% were multigravida. Postdatism was the most common risk factor present in 43.4% patients followed by PIH (20.7%), oligohydramnios (13.7%) and PROM (11.7%). This is comparable to a study by Dhakare et al.[10] where the most common risk factor was Postdatism (35.2%) followed by PIH (31.4%) and oligohydramnios (18.1%).Normal CTG pattern was observed in 68% while suspicious and pathological pattern was observed in 22.6% and 9.4% of high risk pregnancies in our study which is comparable to a study by Kumar A et al.[11] in which 69.4% patients had normal CTG trace while 22.2% and 8.4% had suspicious and abnormal patterns respectively. A total of 155 patients (89.1%) with the normal CTG trace and 16 patients (27.6%) in the suspicious group had vaginal delivery. A total of 6 patients (10.3%) in the suspicious group and 4 patients (16.7%) in the pathological group had instrumental delivery for foetal distress. Observation in the present study shows that for 19 patients (10.9%) with normal CTG trace, caesarean section was done and out of these 16 patients had LSCS for non-progress of labour and 3 patients for CPD. Whereas 62.1% and 83.3% patients underwent LSCS in the suspicious and pathological group respectively.

The association of abnormal pattern in CTG with mode of delivery was found to be statistically significant ($p<0.001$). This result is also comparable to a study by Rose S et al. in which 85%, 38.5% and 11.8% patients with normal, suspicious and pathological trace had vaginal delivery while 15%, 61.5% and 88.2% patients were delivered by LSCS in the normal, suspicious and pathological group respectively. In our present study, meconium stained liquor was present in 19% patients with normal CTG trace while 67.2% in the suspicious and 87.5% in the pathological group had meconium stained liquor. Similar study by Rose S et al. reported meconium stained liquor in 70.6% patients with pathological trace, compared to 24.2% and 30.8% of normal and suspicious group respectively. Similar finding with study by Blessy D et al.[12] & Rahman et al.[1] In Present study, 1.2% of normal, 37.9% of suspicious & 79.2% babies had poor APGAR at 5 minutes (<7). In a similar study by Joshi H et al.[9] 66.7% babies born to ominous group had 5 minute APGAR <7 while 7.42% of reactive and 28.6% of equivocal group babies had 5 minute APGAR <7. In another study conducted by Rose S et al. 3.3% of normal, 38.5% of suspicious and 82.4% of pathological trace babies had poor APGAR at 5 minutes (<7). In present study, our observation shows that 1.2% babies born to mothers with normal trace were admitted in NICU while 56.9% babies of suspicious and 83.3% babies of pathological trace group required admission in NICU. The result is comparable to the study by Rose S et al. in which 0.8% of normal, 23.1% of suspicious and 76.5% of pathological trace babies were admitted in NICU. A similar study by Gupta et al.[13] also revealed that NICU admission increased with nonreactive traces. In our study observation Table-4 shows the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of CTG for neonatal outcome which were calculated based on results of the normal and abnormal (both suspicious and pathological) trace groups. Rose S et al.[7] reported that sensitivity, specificity, positive predictive value and negative predictive value of CTG towards NICU admission were 92.9%, 96.7%, 76.5% and 99.2% respectively and that for 5 minute APGAR score were 77.8%, 97.5%, 82.4% and 96.7% respectively. The specificity and positive predictive value of CTG for NICU admission of our study also corroborated with results reported by Behuria S et al.[14] (95% specificity and 62.5% PPV). Altogether, CTG has high specificity and a good negative predictive value towards 5 minute APGAR and NICU admission. Moreover, the diagnostic accuracy of CTG for 5 minute APGAR and NICU admission was found to be 83.2% and 87.9% in our study. Thus the present study supports the role of intrapartum CTG monitoring in high risk obstetric patients. A normal CTG tracing during labour is a reliable indicator of foetal wellbeing. Further studies are needed to determine convenient supplemental diagnostic modalities which can enhance the positive predictive value of a suspicious or pathological CTG trace.

CONCLUSIONS

Cardiotocography is a simple, non-invasive test that can be used as a screening tool in high risk obstetric patients to

diagnose foetal distress which is already present or is likely to develop during the course of labour and to prevent unnecessary delay in intervention. Thus, it helps in preventing foetal morbidity and mortality. It is cost-effective, easy to perform and causes no inconvenience to the patient. In case of high risk pregnancies with heavy patient burden and low resource setting, CTG can act as a sensitive and specific test in predicting perinatal outcome. However, additional FHR monitoring methods still need to be developed that can reduce the false positive rate for prediction of compromised babies.

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