ORIGINAL ARTICLE

Predictive Accuracy of Intrapartum Cardiotocography in Terms of Fetal Acid Base Status at Birth

Nasira Tasnim, Ghazala Mahmud and Sadia Akram

ABSTRACT

Objective: To find out the predictive value of intrapartum Cardiotocograph (CTG) in terms of fetal acid base status at birth in women undergoing emergency caesarean section for a suboptimal CTG trace.
Study Design: Observational study.
Place and Duration of Study: At the MCH Centre, Pakistan Institute of Medical Sciences, Islamabad, from June 2004 to July 2005.
Methodology: All women undergoing emergency caesarean section for a suboptimal intrapartum CTG were recruited in the study. Immediately after the delivery of the baby a segment of umbilical cord was doubly clamped at a distance of 10 cm, and 2 ml of arterial cord blood was taken in a heparinized syringe for arterial blood gas indices analysis. All CTG tracings were reviewed using FIGO guidelines and compared for fetal arterial blood gas indices.
Results: Of the 57 patients who underwent cesarean section due to suboptimal CTG, 51 (89%) had suspicious trace while 6 (11%) had pathological trace. Positive predictive value of CTG was 18% for fetal hypoxia, 21% for fetal hypercarbia., 26% for fetal acidosis and 37% for base excess. Predictive value of suspicious trace for similar blood indices was 13%, 13%, 17% and 35% respectively. For pathological trace, predictive value was 50%, 83 %, 100% and 66% and respectively.
Conclusion: Based on the results, it is concluded, that the suspicious CTG trace has low predictive value in terms of fetal acid base status at birth and needs to be complemented with other diagnostic modalities before undertaking any operative intervention. Pathological CTG on the other hand is highly predictive of fetal acidosis at birth warranting immediate intervention.

Key words: *Intrapartum CTG. Suboptimal CTG. Fetal acidosis.*

INTRODUCTION

Labour is a stressful event for the fetus but is well tolerated by most. However, in some infants stress of labour in terms of metabolic acidosis can lead to Hypoxic Ischemic Encephalopathy (HIE).[1, 2] Such insults are not limited to high risk pregnancies but can also occur in about 50% of low risk pregnancies.[3] Thus an intrapartum monitoring tool with high accuracy is required to ensure fetal well being in labour. Intermittent auscultation of Fetal Heart Rate (FHR) and electronic fetal monitoring such as Cardiotocography (CTG) are the most popular methods for intrapartum fetal surveillance.[4] Whereas the former focuses only on estimation of basal heart rate, the latter also reflects upon other qualities of fetal hear rate such as variability, accelerations and decelerations.[5] With reduction in the cost of the equipment, electronic fetal monitoring has become a routine in many labour wards and specially at tertiary level hospitals. Despite its popularity, CTG has not proved to be an ideal monitoring tool. Though a normal trace is predictive of a normal acid base status at birth in about 98 % cases, an abnormal trace has a low positive predictive value in terms of fetal pH of < 7.25.[6] Even the most ominous fetal heart patterns are often associated with only 50-65% accuracy for low APGAR score and fetal acidosis at birth.[7] This is partially due to a lack of agreement on nomenclature and definitions for interpretation of fetal heart rate and partly due to inter observer and intra observer bias.

The issue of bias can be solved to some extent through regular audits of CTG tracings against fetal condition at birth. In this regard, both fetal APGAR score and fetal umbilical cord acid base status have been used as a Gold standard. The latter is found to have a better correlation with HIE and thus recommended as a better tool for audit.[8-11]

The aim of this study was to assess the predictive value of intrapartum CTG in terms of fetal acid base status at birth in women undergoing emergency caesarean section.

METHODOLOGY

This study was conducted from June 2004 to July 2005 at the MCH Centre, Pakistan Institute of Medical Sciences, Islamabad. All women with singleton

Department of Obstetrics and Gynaecology, Pakistan Institute of Medical Sciences, Islamabad.

Correspondence: *Dr. Nasira Tasnim, House No. 343-B ,G-8/2, Ravi Road, Islamabad.*
E-mail: attiqkhokhar@yahoo.com

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pregnancies of greater than 36 weeks gestation and cephalic presentation, who underwent emergency caesarean section due to abnormal CTG, and showed no improvement to intrauterine resuscitative measure (oxygen inhalation, intravenous, hydration, left lateral position and stopping of oxytocin drip), irrespective of presence or absence of meconium were recruited in the study. Cases with eclampsia, fetal anomalies, antepartum hemorrhage and chronic maternal medical disorders (cardiac, respiratory or renal disease) were excluded. Delivery was planned either through caesarean section or vaginally if prominent. Caesarean section was performed under spinal anaesthesia in all cases of suspicious CTG, while general anaesthesia was preferred for those with a pathological trace in view of severity of the condition. Immediately after the delivery of the baby, about 10 cm of umbilical cord was doubly clamped. Two milliliters of arterial cord blood was taken in a pre-heparinized syringe and sent to laboratory within 10 minutes for assessment of fetal pH, base excess, PO_2 and PCO_2. The data of each patient was recorded in a pre designed study proforma along with the results of fetal blood sampling. All CTG tracings obtained in late first stage of labour were stored after delivery and reviewed at the time of analysis. Using FIGO guidelines,[12] tracings were categorized into suspicious and pathological.

The suspicious and pathological traces were separately analyzed with respect to fetal arterial blood gas indices at birth. The following reference levels were taken as cutoff limits; PO_2 of < 18 mmHg, PCO_2 of > 50 mmHg, $_pH$ < 7.20 and base deficit > -6.[13]

Data was analyzed through SPSS version 10. Descriptive statistics were used for analysis. Positive predictive values with respect to arterial blood gas indices were calculated for CTG in general and for suspicious and pathological CTG in specific.

RESULTS

There was a total of 735 caesarean section sections performed during the study period. Out of these, 198 (27%) were performed for suboptimal CTG trace. Fifty seven patients fulfilled the study criteria. Decision of caesarean section was based on suspicious CTG in 51 (89%) cases and pathological CTG in 6 (11%) cases.

A majority of the patients (91%) were high risk. The distribution of high risk factors is shown in Table I. The overall predictive value of CTG was 18% for fetal hypoxia, 21% for fetal hypercarbia, 26% for fetal acidosis and 37% for base excess. On further analysis of two major categories of CTG, it was found that pathological CTG had a high predictive value with respect to all fetal blood gas indices. The findings were in contrast to suspicious CTG which had low predictive value in terms of all fetal blood gas indices (Table II).

Table I: Distribution of antepartum and intrapartum risk factors (n=52).

Risk factor	Frequency	Percentage
Pre-labour rupture of membrane	10	19.2
Previous cesarean section	09	17.3
pH	09	17.3
Birth attendant handled	03	5.7
Gestational diabetes mellitus	02	3.8
Fetal growth restriction	02	3.8
Isolated oligohydramnios	07	13.4
Post-dates	05	9.6

Table II: Predictive value of suspicious and pathological CTG in terms of fetal arterial blood gas indices (n=57).

Blood gas indices/ category of CTG	Abnormal outcome	Normal outcome	Positive predictive value
PO_2 < 18 mmHg			
Suspicious CTG (n=51)	7	44	13%
Pathological CTG (n=06)	3	3	50%
PCO_2 > 50 mmHg			
Suspicious CTG	7	44	13%
Pathological	5	1	83.3%
pH < 7.2			
Suspicious	9	42	17.6%
Pathological	6	0	100%
Base excess > -6			
Suspicious	18	33	35%
Pathological	4	2	66%

DISCUSSION

A rising caesarean section rate is a major issue in the present era. Suboptimal CTG is one of the major contributors to this high caesarean section rate, accounting for 10-25% of cases.[14] More alarming is the fact that almost 63% of them are based on non reassuring/suspicious CTG and about 30% of these are unnecessary.[15] The figures were even higher in this study where 27% cesarean sections were performed for suboptimal CTG. Of these, 89% were based on suspicious trace. The predictive accuracy of these tracings for fetal acidosis at birth was 17% indicating that more than 80% cesarean sections based on these traces were unnecessary. Further analysis in this regard showed that 85% of these cases had one or more coexisting risk factors which might have reduced the threshhold for operative intervention. These observations are supported by Chuhan who has reported a 20% risk of cesarean section for presumed fetal jeopardy in this subset of the population.[16]

A low predictive value for suspicious trace has also been observed in other studies with values ranging from 12% to 29%. These observations suggest that the diagnosis of non-reassuring fetal status should not be based solely on a suspicious CTG but should be confirmed through other modalities. Various modalities have been tested as complementary tools. These include fetal ECG, fetal pulse oximetry, fetal scalp lactate levels and fetal blood pH estimation. The latter remains the gold standard but is invasive, time consuming (18 minutes as minimum),

requires additional expertise and needs to be repeated.[19] Under these circumstances ultrasound based intrapartum biophysical profile is the most readily available complementary tool and has been found to have a better predictive accuracy than CTG alone.[17,18]

In contrast to suspicious CTG, pathological trace was found to have a high predictive value for fetal acidosis (100%), justifying the need for urgent intervention. The figure is much higher than that quoted by Maclachan, Sheikh and Pallintova as 38%, 58% and 36.2% respectively.[20-22] The probable reason for these differences are inter observer bias in the visual interpretation of tracings and a variable time interval between diagnosis and delivery .The former issue may be resolved through the institution of computerized CTG while the latter may be dealt with through minimization of decision-delivery interval, the upper cut off limit of which has been set at 30 minutes.[23]

In contrast to fetal pH, the predictive value of pathological CTG for other arterial blood gas indices was low. Similar observations have been made by other authors.[18,19] The explanation given by these authors for such an occurrence is that these indices are influenced by a number of maternal and fetal factors, such as maternal hyperventilation, maternal pre-oxygenation, the time of clamping of cord (before or after the first breath) and mixing of external air in the syringe. Lack of standardization of heparinized syringes and varied time interval between sample collection and ABG analysis may be other contributing factors. Despite a low predictive value for these indices, analysis of all is recommended by the American College of Gynecology when auditing caesarean sections for presumed fetal distress.

The study has some limitations which need to be highlighted. Standardization in the sampling technique was not ideal. Distance from the operation theatre to the laboratory was another major influencing factor in timely analysis and achieving accurate results.

Due to the high cost of analysis, sampling was restricted to those with non-reassuring fetal status thus lacking a control arm. While comparing the two major categories of CTG, pathological tracings were too few to make a true comparison with suspicious tracings. Large scale comparative cross sectional trials may prove more fruitful in this regard. Another issue concerns the distribution of risk factors among the study population. As a majority of the patients belonged to a high risk category, the influence of individual risk factors on acid base status at birth can not be excluded. The findings may not be generalized to be applied on low risk group and thus separate studies are required for this subset of the population.

CONCLUSION

Based on the limited data of pathological CTG, it is concluded that these patterns are highly predictive of fetal acidosis at birth, which may be detrimental to the fetus, causing an irreversible hypoxic brain damage, especially in a high risk population. The suspicious tracings on the other hand have low predictive value for fetal hypoxia and fetal acidosis at birth and could be confirmed with other intrapartum surveillance tools to reduce unnecessary caesarean sections. Further trials are however, suggested in order to standardize intrapartum management protocol.

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