RELIABILITY OF ADMISSION CARDIOTOCOGRAPHY IN PREDICTING ADVERSE PERINATAL OUTCOME IN LOW RISK OBSTETRIC POPULATION

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Abstract

Objectives: To assess the reliability of the admission cardiotocogram in detecting fetal hypoxia already present at admission and to correlate the results of the admission test with the perinatal outcome in low risk obstetric population.

Methods: This was a cross-sectional study conducted during the period 2008 to 2010. The study included 192 low risk pregnant women, admitted to the emergency department or through the outpatient department with period of gestation ≥37 weeks, in first stage of labor with fetus in cephalic presentation. All of them were subjected to an admission test, a 20 minutes recording of fetal heart rate and uterine contractions on cardiotocograph machine at the time of admission.

Results: The results of the admission test were 'reactive' in 88%, 'equivocal' in 5.7% and 'ominous' in 6.3% women. Women with the reactive admission test had low risk of intrapartum fetal distress (2.9%) as compared to 36.4% in the equivocal and 83.3% in the ominous group (p<0.001). Incidence of moderate to thick meconium stained liquor was significantly high in ominous (66.7%) and equivocal group (18.2%), as compared to reactive group (2.4%). Incidence of neonatal intensive care unit (NICU) admission was also significantly high (about 42%) in babies delivered from mother in ominous test group as compared to those with equivocal (27%) and reactive (1.2%) test groups. Operative delivery for fetal distress was required in only 2.3% (4 of 169) women of the reactive group, in 36.3% (4 of 11) women of the equivocal group and in 83.3% (10 of 12) women of the ominous group.

Conclusion: The admission cardiotocography is a simple non-invasive test that can serve as a screening tool in low risk obstetric population in obstetric wards of non-industrialized countries with a heavy workload and limited resources to help in ‘triaging’ fetuses.

Key words: Admission test, Cardiotocography, Fetal distress, Perinatal outcome.

Background and objectives

Labor is the most crucial period for the fetus as this is the only time to see whether it can sustain hypoxia due to stress of contraction. Early diagnosis of fetal hypoxia before the permanent damage occurs is a major challenge in the obstetric practice. Therefore, the concept of intrapartum surveillance is executed. The easiest way of doing this is by monitoring the fetal heart rate (FHR). Intrapartum assessment of fetal well-being has evolved over the last 40 years, with the primary focus being fetal FHR assessment. Fetal heart rate monitoring maintains its role as a common intervention in obstetric unit. For this purpose, electronic fetal monitoring (EFM) has widely been adopted. Although with intermittent auscultation the baseline FHR can be measured, other features of the fetal heart such as baseline variability, accelerations and decelerations are difficult to quantify. Due to this fact, the use of antepartum and intrapartum cardiotocography (CTG) has increased during the last 15 years. As a consequence a considerable decrease has been noted in the overall perinatal mortality and today CTG is first line investigation for ante and intrapartum fetal assessment.

Routine electronic monitoring of FHR in labor has become an established obstetric practice in the industrialized countries. Economic constraints in many parts of the world limit routine and continuous monitoring. In busy labor wards with few monitors, selection of the patients for continuous monitoring is necessary. Presently an antenatal risk classification is used for this purpose which recommends continuous monitoring for high risk patients. Unfortunately risk assessment profiles are often insufficient tools for selection. Intrapartum fetal morbidity and mortality are not uncommon in low risk populations especially in low resource countries where the antenatal care is inadequate and deliveries are conducted in crowded settings with inadequate health care provider to patient ratios, and FHR changes and fetal acidosis might occur abruptly with the same as in high-risk group.

Ingemarsson et al described an alternative method of monitoring FHR during labor, to pick the apparently low risk women whose fetus is compromised on admission or is likely to become compromised in labor after the admission test (AT).
The admission cardiotocogram is a short, usually 20 minutes, recording of the fetal heart rate immediately after admission to the labor ward. The main justification for admission cardiotocography is that the uterine contractions of labor put stress on the placental circulation, an abnormal tracing might indicate a deficiency and hence identify potential fetal compromise at an early enough stage to allow necessary intervention.

Hence, low risk labors are electronically monitored for a short period on admission to the labor ward, and continuous EFM follows only if abnormalities in the FHR are identified.

The objective of this study was to assess the reliability of the admission cardiotocogram in detecting fetal hypoxia already present at admission to predict hypoxia in labor and to correlate the results of the AT with the perinatal outcome in low risk obstetric population and thus reduce the neonatal morbidity and mortality by early intervention.

Material and methods

Study design and setting

The study conducted during the period 2008 to 2010, was a prospective, cross-sectional, single centered study at the Labor and Maternity ward, department of Obstetrics and Gynaecology at Central Referral Hospital (CRH)-teaching hospital of Sikkim Manipal Institute of Medical Sciences (SMIMS), Gangtok, India. Written informed consent was obtained from the women who participated in the study.

Inclusion and exclusion criteria

Women were eligible to join the study if they were booked for hospital delivery with a period of gestation ≥ 37 weeks, in first stage of labor with fetus in cephalic presentation and patients had been classified low risk during the antenatal period and had no obstetric complications at that visit. Women who were excluded from the study were period of gestation <37 weeks, any evidence of risk factor obstetric complication on admission (pre-eclampsia, diabetes-over or gestational, suspected intrauterine growth restriction (IUGR), multiple pregnancies, abnormal lie and presentation, patients those who were identified for elective lower segment caesarean section (LSCS) like previous caesarean section, ultrasonography (USG) confirmed lethal congenital anomaly of fetus, acute hypoxic states like abruption of placenta, cord prolapse, uterine scar rupture etc.

Admission test procedure and monitoring

One hundred and ninety two (192) pregnant women admitted in the first stage of labor were recruited for this study who met the inclusion criteria. On admission, women’s detail history including age, parity, antenatal care, menstrual, obstetric and medical history were documented. General physical examination was done. Per abdominal and bimanual examination were performed to determine the stages of labor, following which patients were subjected to AT. Corometrics 170 CTG machine (for cardiotocography) was used. A tracing was taken for 20 minutes in a semilateral position in a separate room beside first stage labor room. The FHR traces thus obtained were categorized as reactive, equivocal or ominous as according to the classification proposed by NICE (National Institute of Clinical Excellence- Clinical guideline September 2007).

Following the AT, patients with reactive trace were monitored intermittently by auscultation for one minute every 30 minute in first stage of labor and every 5 minutes in second stage of labor post contraction. Cases with equivocal trace were put on continuous CTG monitoring. In those with ominous tracings, appearance of late, significant variable or prolonged decelerations, delivery was consequently hastened by operative or instrumental intervention depending upon stage of labor. After delivery, the liquor color, and Apgar score of each neonate were determined. Babies who were depressed at birth and whose Apgar was low (<7 at 5 min), their cord blood pH was estimated.

Fetal and neonatal outcome

Fetus/neonate was considered to be in distress if any of the following were present:-
1. Ominous FHR changes led to caesarean section (LSCS) or forceps/ventouse delivery.
2. Presence of moderate - thick meconium stained liquor.
3. Apgar score at 5 minutes < 7.
4. Umbilical cord arterial blood PH < 7.2
5. Admission into neonatal intensive care unit (NICU) for birth asphyxia
6. Neonatal seizures within first 24 hrs to 48 hrs.

Statistical analysis

Data obtained from the study groups were analyzed and statistically verified by nonparametric Chi-square test (x² test) with the use of computer software SPSS version 10. Statistical significance was calculated between reactive and nonreactive group where ever possible. A p-value of <0.05 was considered as the definition of statistical significance.

Results

Majority of the women were between the age group of 21-30 years (71%) and primigravida (61%). Only 2.9% of women with reactive admission test (88%) showed evidence of fetal distress. Of the eleven (5.7%) women who had equivocal trace, five (36.4%) babies had fetal distress, whereas 83% babies born to women with ominous admission test had fetal distress. It is evident from (Table 1) that incidence of fetal distress significantly increase with worsening of admission test (p<0.001).
About 67% patients with ominous test had moderate-thick MSL, compared to 18% and 2.4% in equivocal and reactive AT group respectively (p<0.001). Forty two percent of babies born to patients with ominous AT had NICU admissions compared to 27% and 1.2% of those babies born to patients with equivocal and reactive AT respectively (p<0.001).

Table 2 shows that incidence of birth asphyxia was significantly high in ominous and equivocal groups as compared to reactive group when new born were assessed by Apgar score <7 at 5 minute and/or cord blood pH<7.2. There was no intrapartum/neonatal death in babies born to mothers in reactive and equivocal AT groups, whereas one baby (8.3%) died in ominous test group due to birth asphyxia.

Incidence of spontaneous vaginal delivery was high (83.4%) when the test was reactive. An important observation was that of the 28 (16.6%) patients in the reactive group who underwent instrumental-operative delivery, only in 4 patients indication was fetal distress and in other 24 patients indication was other than fetal distress, mostly non progression of labor. Six patients (55.6%) in the equivocal group and ten patients (83.3%) in the ominous group had instrumental/operative delivery and in majority of these patients indication was fetal distress. Incidence of operative delivery significantly increases as the admission test result worsens (Table 3).

Table 1. Admission test result and incidence of fetal distress
{Data are expressed in number (n) and percentage (%)}

<table>
<thead>
<tr>
<th>Results</th>
<th>AT result</th>
<th>Fetal distress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Equivocal</td>
<td>11</td>
<td>5.7</td>
</tr>
<tr>
<td>Ominous</td>
<td>12</td>
<td>6.3</td>
</tr>
</tbody>
</table>

**P-value <0.001 (statistical significance was calculated between reactive, equivocal and ominous groups)**

Table 2. Correlation of fetal/neonatal outcomes with admission test
{Data are expressed in number (n) and percentage (%)}

<table>
<thead>
<tr>
<th></th>
<th>Reactive (n=169)</th>
<th>Equivocal (n=11)</th>
<th>Ominous (n=12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mod-thick MSL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APGAR score at 5 min &lt;7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NICU admission</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cord blood pH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neonatal death</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**P-value <0.001 (statistical significance was calculated between reactive, equivocal and ominous groups)**

Table 3. Mode of delivery with the results of the admission test and occurrence of fetal distress
{Data are expressed in number (n) and percentage (%)}

<table>
<thead>
<tr>
<th>Mode of delivery</th>
<th>Reactive (n=169)</th>
<th>Equivocal (n=11)</th>
<th>Ominous (n=12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous Vaginal Delivery</td>
<td>141 (83.4%)</td>
<td>5 (45.4%)</td>
<td>2 (16.7%)</td>
</tr>
<tr>
<td>With fetal distress</td>
<td>1 (0.7%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Without fetal distress</td>
<td>140 (99.3%)</td>
<td>5 (100%)</td>
<td>2 (100%)</td>
</tr>
<tr>
<td>Forceps/Ventouse</td>
<td>12 (7.1%)</td>
<td>2 (18.2%)</td>
<td>2 (16.7%)</td>
</tr>
<tr>
<td>With fetal distress</td>
<td>1 (8.3%)</td>
<td>2 (100%)</td>
<td>2 (100%)</td>
</tr>
<tr>
<td>Without fetal distress</td>
<td>11 (91.7%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LSCS</td>
<td>16 (9.5%)</td>
<td>4 (36.4%)</td>
<td>8 (66.6%)</td>
</tr>
<tr>
<td>With fetal distress</td>
<td>3 (18.8%)</td>
<td>2 (50%)</td>
<td>8 (100%)</td>
</tr>
<tr>
<td>Without fetal distress</td>
<td>13 (81.2%)</td>
<td>2 (50%)</td>
<td>-</td>
</tr>
</tbody>
</table>
Discussion

In 1989, American Congress of Obstetricians and Gynecologists (ACOG) indicated that “fetuses of laboring women could be assessed by electronic fetal monitoring or by intermittent auscultation of fetal heart tones”.

Auscultation however is necessarily intermittent, subjective and difficult to verify and document. Also in developing countries like India, with busy labor wards and a minimum staff, sole reliance on auscultation is often ineffective.

Use of electronic fetal heart rate (FHR) monitoring at the time of admission in labor has been employed by some centers to identify fetuses that are at an increased risk of hypoxia. This provides a ‘snap-shot’ view of fetal well-being at the time of admission in labor.\(^7\)

Uterine contractions serve as a functional stress to the fetus: a short tracing of FHR on admission in labor ward may thus detect fetal intrauterine hypoxia already present on admission and may have some predictive value for hypoxia that may develop during labor.\(^7\)

In the present study, 2.9% babies from reactive group, 36.4% babies from equivocal group, and 83.3% babies from the ominous group showed evidence of fetal distress. Hegde et al.\(^11\) also reported similar rates (i.e. 3.6% in reactive, 15% in equivocal group and 75% in ominous group) of fetal distress in their study. Ingemarsson et al.\(^8\) in their study observed development of fetal distress in 1.3% of the reactive group, 10% of the equivocal group and in 40% of the ominous group babies. In the present study we observed women with the reactive AT have low risk (1.2%) of developing intrapartum fetal hypoxia and significantly high risk in the ominous group (33.3%) when assessed by apgar score and/ cord blood pH <7.2. Libiran MJ et al.\(^7\) also reported 6.5% risk of fetal asphyxia in the reactive group, and 50% risk in the ominous group babies when assessed by apgar score and umbilical cord blood pH.

Operative delivery for fetal distress was required only in 2.3% (4/169) patients in the reactive group, 36.3% (4/11) in the equivocal group and 83.3% (10/12) in the ominous group. Ingemarsson et al.\(^8\) also observed operative delivery rate of 1.35% in the reactive group, 8.2% in the equivocal group and 50% in the ominous group. Elimian et al.\(^8\) was also in favor that women with non reactive AT are more likely to be delivered by LSCS, to have fetal distress resulting in caesarean section and to have longer neonatal hospital stay.

The admission CTG therefore has two potential roles. It can be used as a screening test in early labor to detect compromised fetuses on admission and to select the women in need of continuous fetal electronic monitoring during labor.\(^7\) Detractors of electronic fetal monitoring like Impey et al.\(^9\) believe that neonatal outcome is not significantly improved by the use of admission testing as compared to intermittent fetal heart rate auscultation during labor. Thacker et al.\(^9\) also feel that the use of electronic fetal monitoring is of limited effectiveness and carries an increased risk of interventions. According to them increased information at admission will not necessarily lead to better clinical outcomes. This may be true in industrialized countries provided that patients receive comprehensive antenatal care and personal attention during labor. The same may not be true for non-industrialized countries where the antenatal care is inadequate and deliveries are conducted in crowded settings and inadequate health care provider to patient ratios. The AT has a role in obstetric units with a heavy workload (>10,000 deliveries/year) in non-industrialized countries with limited resources to help in ‘triaging’ fetuses.\(^7\)

Table 4 shows that AT has high specificity (95%) and low false positivity. Ingemarsson et al.\(^8\) also reported a very high (99%) specificity of the AT. The high specificity of the admission test means that a normal test accurately excludes adverse fetal status at the time of testing.

Table 4. Sensitivity and specificity of admission test

<table>
<thead>
<tr>
<th></th>
<th>Present study</th>
<th>Ingemarsson et al. (1984-85)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>73.7%</td>
<td>23.5%</td>
</tr>
<tr>
<td>Specificity</td>
<td>94.8%</td>
<td>99.4%</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>60.9%</td>
<td>40.0%</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>97.0%</td>
<td>98.7%</td>
</tr>
<tr>
<td>False negatives</td>
<td>26.3%</td>
<td>76.5%</td>
</tr>
<tr>
<td>False positives</td>
<td>5.2%</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

Five patients with reactive AT had fetal distress in labor. It was found that in all of them AT-delivery interval was more than 12 hours. It can be explained from the fact that an AT cannot be expected to predict fetal distress after several hours of labor with other influencing factors like problems of cord, prolonged labor etc. which may become operational as labor progresses.\(^7\) Therefore, in cases where admission test delivery interval is expected to be prolonged, it is good to repeat CTG to detect fetal distress. Studies are required to define specific time interval to repeat CTG to detect fetal distress in reactive admission test. Further Studies are needed which define the role of AT in patients with specific pregnancy complications. Studies are also required to determine the convenient supplemental diagnostic modalities which can enhance the positive predictive value of an equivocal/abnormal AT.

Conclusion

The admission cardiotocography is a simple noninvasive test that can serve as a screening tool in low risk obstetric population to detect fetal distress already present or likely to
develop and prevent unnecessary delay in intervention. Thus it helps in preventing fetal morbidity and mortality. As the test has high specificity, it has role in obstetric wards of non-industrialized countries with a heavy workload and limited resources to help in ‘triaging’ fetuses.

References


12. Myer S. Bornstein and Louise Nunnley, R.N: Cord blood gases to determine umbilical artery acid base analysis. Available from:


