Admission test as a predictor of foetal outcome in term pregnancies

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DOI: https://doi.org/10.33545/gynae.2024.v8.i4b.1480

Abstract

Background: Cardiotocography (CTG) is widely used for foetal monitoring during pregnancy and labour to assess foetal well-being and predict adverse perinatal outcomes. This study evaluates the role of Cardiotocography in predicting foetal outcomes in both high-risk and low-risk pregnancies.

Methods: A cross-sectional study was conducted on 200 pregnant women in labour admitted to a tertiary care center. Participants were categorized into high-risk (N=95) and low-risk (N=105) groups based on obstetric history and clinical parameters. CTG results were classified as normal, suspicious and pathological. Outcomes were measured which included mode of delivery, foetal distress, meconium stained, Apgar scores, resuscitation needed, NICU admissions and duration of hospital stay.

Results: Age Distribution: Participants were primarily young adults, with a mean age of 24.11 years (SD = 3.37). Gestational Age: Mean gestational age was 38.475 weeks (SD = 0.8572).

Risk Categories: 47.5% (N=95) of participants were high-risk, and 52.5% (N=105) were low-risk.

CTG Results: 29% (N=58) had pathological (ominous) CTG results, 60% (N=120) were normal, and 11% (N=22) were suspicious.

Mode of Delivery: Cesarean sections were performed in 30.5% (N=61), instrumental deliveries in 18.5% (N=37), and normal vaginal deliveries in 51% (N=102). Pathological CTG results were significantly associated with a higher rate of cesarean sections (46.6%).

Perinatal Outcomes: Pathological CTG results correlated with lower Apgar scores at 1 and 5 minutes, higher NICU admissions and prolonged hospital stays. For example, pathological CTG results were associated with an Apgar score of 6.47 at 1 minute and 7.19 at 5 minutes compared to reactive CTG results (Apgar scores of 8.07 and 8.52, respectively).

Statistical Analysis: Significant associations were found between CTG results and mode of delivery (P=0.001), foetal distress (P=0.001) and NICU admissions (P=0.001).

Conclusions: CTG is a valuable tool in predicting perinatal outcomes in both high risk and low risk categories, particularly in high-risk pregnancies. Pathological CTG results are strongly associated with adverse outcomes such as lower Apgar scores, increased NICU admissions and higher rates of cesarean sections. These findings underscore the importance of CTG in the management and decision-making process in high-risk pregnancies.

Keywords: Cardiotocography (CTG), foetal monitoring, high-risk pregnancies, perinatal outcomes, Apgar score, NICU admissions, cesarean section, fetal distress, pathological CTG

Introduction

Obstetricians and gynecologists strive to predict the prognosis of neonates during delivery due to the potential risk for hypoxia and injuries caused by stress and contractions during labor. Globally, approximately 23% of neonatal deaths each year are attributed to intrapartum complications. While severe fetal hypoxia from acute events such as placental abruption, uterine rupture or cord prolapse is rare, most cases of fetal hypoxia occur gradually due to uterine contractions. Placental function typically manages the hypoxic stresses of labor but some women may develop intrapartum fetal compromise, leading to perinatal hypoxia a major factor in stillbirth, cerebral palsy and hypoxic-ischemic encephalopathy (HIE) [1-3].

Modern medical technology allows for the identification of fetuses unable to withstand periods of intermittent hypoxia manifesting through heart rate abnormalities and passage of meconium in utero. These indicators facilitate patient management and underscore the importance of intrapartum fetal well-being assessment in labor management. In developed countries, continuous monitoring of fetal heart rate (FHR) is widely used to identify the risk of asphyxia during labor, employing both internal and external methods, with external methods being more common due to their non-invasive nature.
The labor admission test, comprising a cardiotocography (CTG) of 20–40 minutes duration carried out on admission to the maternity ward was introduced as a screening tool to detect compromised fetuses on admission and to select women in need of continuous fetal electronic monitoring during labor. This test assesses all parameters of fetal heart rate, including baseline variability, which is not possible with auscultation alone. The Admission Test provides reassurance that the fetus is not at risk of hypoxia at the time of admission and is unlikely to develop hypoxia in the next few hours. While the test's significance may be limited in developed countries due to the availability of comprehensive antenatal care and intrapartum fetal monitoring, it can be a valuable tool in developing countries. [46]

Despite its widespread use, there remains debate regarding the predictive value of the Admission Test. Risk assessment based on antepartum factors may not accurately predict fetal outcomes as fetal heart rate changes and fetal acidosis can occur with the same frequency in both high-risk and low-risk groups. Therefore, the Admission Test can be a useful screening tool in early labor to detect compromised fetuses on hospital admission. This study aims to evaluate the efficacy of the Admission Test in assessing fetal well-being at the onset of labor.

**Aims and Objectives**
1. To evaluate the admission test in high-risk and low-risk groups.
2. To assess the role of the admission test in predicting adverse outcomes in intrapartum patients admitted to the labor ward.

**Methodology**

**Study Design:** This is a hospital-based cross-sectional study.

**Source of Duration:** The study was conducted over a period of two years starting in July 2022 to June 2024.

**Study Area:** MVJ Medical College and Research Hospital, Hoskote, Bangalore.

**Sample Size:** A total of 200 women in labor were recruited for the study of which 100 women admitted to the labor ward (both low-risk and high-risk) in labor and 100 term pregnant women attending the OPD who were in labor were admitted and were selected for the study.

**Inclusion Criteria**
- Pregnant patients with gestational age of 37 to 40 weeks.
- With labor pains, either spontaneous or accelerated.
- With cephalic presentation.

**High-risk cases**
- Post-dated pregnancy
- Pregnancy-induced hypertension
- IUGR / Oligohydramnios
- Rh-negative pregnancy
- Long period of primary infertility
- Bad obstetric history
- Heart disease
- Anemia
- Previous LSCS

**Exclusion Criteria**
- Antepartum hemorrhage
- Multiple pregnancy
- Major anomalies of the fetus
- Gestational age of fetus <36 weeks

**Methods of Data Collection**
- All selected pregnant women in labor and their attendants were informed about the procedure and their consent was obtained.
- Clinical evaluation was performed through detailed history and examination.
- Cardiotocography (CTG) was used for fetal heart rate monitoring.
- Patients with normal tracings were followed up by intermittent auscultation and electronic monitoring every 4 to 5 hours. Labor progress was closely monitored and emergency intervention was made if fetal distress was suspected.
- Patients with suspicious or pathological (ominous) tracings, underwent immediate ARM (Artificial Rupture of Membranes) and the color of the liquor was assessed and in cases of meconium-stained amniotic fluid delivery was terminated by instrumental or cesarean section if necessary.
- Data on clinical history, examination, treatment, and investigations were collected using a proforma.

**Statistical Analysis**
The data were collected and compiled in MS Excel. Descriptive statistics were used to present the data. SPSS (Version 26.0) was used for data analysis. A significance level of 5% (α = 0.05) was fixed. Qualitative variables were expressed as frequency and percentages, quantitative variables were expressed as mean and standard deviation. Chi-square test was used to compare proportions, Student’s t-test and ANOVA were used to compare mean values.

**Results**
The mean age was 24.11±3.37 years. Of the total participants, 56% (N=112) were booked cases whereas 44% (N=88) were unbooked. The majority of participants were multigravida (65.5%, N=131) with primagravida constituting 34.5% (N=69). The mean gestational age of the participants was 38.47±0.8572 weeks. Participants were almost evenly split between high-risk (47.5%, N=95) and low-risk (52.5%, N=105) categories indicating a balanced risk distribution within the cohort (Table 1).

**Table 1: General characteristics**

<table>
<thead>
<tr>
<th>General Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, Mean ± SD</td>
<td>24.11±3.37</td>
</tr>
<tr>
<td>Risk Category</td>
<td></td>
</tr>
<tr>
<td>High-Risk Cases</td>
<td>95 (47.5%)</td>
</tr>
<tr>
<td>Low-Risk Cases</td>
<td>105 (52.5%)</td>
</tr>
<tr>
<td>Parity</td>
<td></td>
</tr>
<tr>
<td>Multigravida</td>
<td>131</td>
</tr>
<tr>
<td>Primigravida</td>
<td>69</td>
</tr>
<tr>
<td>Booking Status</td>
<td></td>
</tr>
<tr>
<td>Booked</td>
<td>112</td>
</tr>
<tr>
<td>Unbooked</td>
<td>88</td>
</tr>
<tr>
<td>Gestational Age, Mean ± SD</td>
<td>38.47±0.8572</td>
</tr>
</tbody>
</table>

The CTG results were predominantly normal (reactive) (60%, N=120) with pathological (ominous) results in 29% (N=58) and suspicious results in 11% (N=22) of cases, highlighting a majority of normal fetal heart rate patterns (Figure 1). The distribution of CTG results between high-risk and low-risk categories did not show significant differences (P=0.746). Normal results were more common in both high-risk (57.9%, N=55) and low-risk (61.9%, N=65) cases (Figure 2).
CTG results significantly influenced the mode of delivery \( (P=0.001) \). Pathological results led to a higher rate of cesarean sections (46.6\%, \( N=27 \)) whereas Normal results were more associated with normal vaginal deliveries (65.8\%, \( N=79 \)), (Figure 3).

CTG results significantly influenced the need for neonatal resuscitation \( (P=0.001) \). Pathological results were more likely to require resuscitation (55.2\%, \( N=32 \)), compared to Normal results (2.5\%, \( N=3 \)), (Table 3).

CTG results significantly influenced the NICU admission \( (P=0.0001) \). Pathological results were more likely to have meconium staining (56.9\%, \( N=33 \)) compared to normal results (36.7\%, \( N=44 \)), (Figure 4).
CTG results significantly affected NICU admission rates (P=0.0001). Pathological results were more likely to lead to NICU admission (43.1%, N=25), compared to Normal results (11.7%, N=14), (Table 4).

High-Risk Group
In the high-risk group, several key associations were observed between CTG results and perinatal outcomes. Pathological CTG results were found to be significantly associated with fetal distress with 21.4% (6 out of 28) cases showing fetal distress. This contrasts with normal CTG results, where only 7.7% (5 out of 65) of cases were associated with fetal distress. The presence of meconium-stained liquor was noted in 45% of cases with pathological CTG results, compared to only 15% of cases with normal CTG results. This suggests a strong association between pathological CTG findings and the presence of meconium-stained liquor, which is a marker of fetal distress. Regarding the mode of delivery, 50% of cases with pathological CTG results required cesarean sections, while only 20% of cases with normal CTG results needed cesarean sections. This underscores the increased likelihood of operative delivery in cases with abnormal CTG findings. The Apgar scores at 1 minute were significantly lower in cases with pathological CTG results with 40% of neonates scoring below 7 compared to only 10% in the normal CTG group. At 5 minutes, this trend continued with 30% of neonates in the pathological CTG group scoring below 7 compared to 5% in the normal CTG group. The need for neonatal resuscitation was also higher in the pathological CTG group with 35% requiring resuscitation compared to 10% in the normal CTG group. Neonatal ICU admissions were more frequent in the pathological CTG group with 25% requiring admission compared to 8% in the normal CTG group (Table 5).

CTG group. Neonatal ICU admissions were required for 10% of the pathological CTG group and 5% of the normal CTG group (Table 6).

Table 5: Association of CTG result in high risk group

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Pathological</th>
<th>Suspicious</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fetal Distress</td>
<td>5.5</td>
<td>4.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Meconium-Stained Liquor</td>
<td>10.0</td>
<td>7.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Cesarean Sections</td>
<td>25.0</td>
<td>15.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Apgar Score &lt; 7 at 1 min</td>
<td>15.0</td>
<td>10.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Apgar Score &lt; 7 at 5 min</td>
<td>15.0</td>
<td>5.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Neonatal Resuscitation</td>
<td>10.0</td>
<td>8.0</td>
<td>3.0</td>
</tr>
<tr>
<td>NICU Admissions</td>
<td>10.0</td>
<td>7.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Low-Risk Group
In the low-risk group, the associations between CTG results and perinatal outcomes were notably different. Pathological CTG results were less frequent and their association with adverse outcomes was not as pronounced as in the high-risk group. Fetal distress was observed in 5.5% (2 out of 36) cases with pathological CTG results compared to 2% (1 out of 50) of cases with normal CTG results. Meconium-stained liquor was present in 10% of cases with pathological CTG results and 3% of cases with normal CTG results. This indicates a lower incidence of meconium-stained liquor in the low-risk group even among those with pathological CTG findings. The mode of delivery in the low-risk group showed that 25% of cases with pathological CTG results required cesarean sections while only 10% of cases with normal CTG results needed cesarean sections. This difference, while significant, is less marked than in the high-risk group. Apgar scores at 1 minute were below 7 in 15% of cases with pathological CTG results compared to 5% in the normal CTG group. At 5 minutes, 10% of neonates in the pathological CTG group scored below 7 compared to 2% in the normal CTG group. The need for neonatal resuscitation was observed in 10% of the pathological CTG group compared to 3% in the normal CTG group. Neonatal ICU admissions were required for 10% of the pathological CTG group and 5% of the normal CTG group (Table 6).

Table 6: Association of CTG result in low risk group

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Pathological</th>
<th>Suspicious</th>
<th>Normal</th>
</tr>
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<td>Apgar Score &lt; 7 at 5 min</td>
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<td>NICU Admissions</td>
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</tr>
</tbody>
</table>

Discussion
Our study findings align with other research on the association of CTG results with in our study, the majority of participants were between 21-25 years of age (41%), followed by 26-30 years (37%) and 18-20 years (22%). The mean age was 24.11 years. In a study done by Nity and Das, the majority of patients were in the age group of 21-25 years (40.5%) [7]. This age distribution indicates a focus on younger women similar to our study population, which may reflect the general demographic profile of pregnant women seeking care in this setting. In a study by Akhavan et al., the mean age of participants was slightly higher, at 29 years [8]. This study included a broader age range which might be due to the inclusion of a more diverse population in terms of risk factors and health status.

Parity
In our study, 65.5% of participants were multigravida, and 34.5% were primigravida. This indicates a higher proportion of women with previous pregnancies. Nity and Das reported that the majority of their patients were primigravida (61.8%). This contrasts with our findings and might be due to differences in the population characteristics or healthcare practices at the study sites [7].

Gestational Age
In our study, the mean gestational age was 38.475 weeks. Most deliveries occurred at full term, indicating good pregnancy management and timely intervention. Nity and Das found that the majority of patients in their study were more than 37 weeks of gestational age (68.3%). This is consistent with our findings and reinforces the focus on full-term pregnancies in monitoring and managing high-risk cases [7].

Cardiotocography (CTG) Result
In our study, 60% of the CTG results were normal (reactive), 29% were pathological (ominous) and 11% were suspicious. This distribution highlights the effectiveness of CTG in identifying fetal distress. In the study by Nity and Das, the admission test results were categorized as normal in 68.7%, suspicious in 21.7%, and pathological in 9.6% of cases [7]. The incidence of fetal distress, meconium-stained liquor, NICU admission, and low APGAR scores was significantly higher with pathological AT compared to suspicious and normal AT results. Akhavan et al. reported that 33.4% of the women had abnormal ATs [8]. They found that abnormal ATs were predictive of higher cesarean rates, NICU admissions, and lower Apgar scores but could not predict neonatal death and hypoxia.

Mode of Delivery
In our study, normal vaginal delivery was the most common mode (51%) followed by cesarean section (30.5%) and
instrumental delivery (18.5%). Nity and Das reported that spontaneous vaginal delivery was performed in 53.1% of patients, cesarean section in 35.2% and instrumental deliveries in 11.7%. The incidence of cesarean section was higher in the pathological AT group compared to normal and suspicious AT groups. Akhavan et al. found that abnormal ATs were associated with higher cesarean section rates. This supports the use of AT in identifying cases that may require surgical intervention to ensure better neonatal outcomes [9].

Role of CTG in Labour
In our study, the use of cardiotocography (CTG) on admission revealed significant insights into fetal well-being during labor. We found that 60% of CTG results were normal, indicating normal fetal heart rate patterns, while 29% were pathological and 11% were suspicious. This distribution highlights CTG's effectiveness in identifying potential fetal distress early on. Specifically, pathological CTG results were strongly associated with increased rates of cesarean sections and neonatal intensive care unit (NICU) admissions, indicating the test's utility in guiding timely interventions to improve neonatal outcomes. A study conducted by Nity and Das reported that 68.7% of admission tests were classified as normal, 21.7% as suspicious, and 9.6% as pathological [7]. Akhavan et al. demonstrated the prognostic value of CTG with 33.4% of their participants exhibiting abnormal CTG results. A Cochrane review highlighted that while CTG is widely used, its benefit in low-risk pregnancies is debatable. The review found no evidence of significant benefit for low-risk women and noted an increased cesarean section rate associated with CTG use. This underscores the importance of considering the patient's risk profile when deciding on the use of CTG [9]. A study by Seravalli et al. explored the timing of hospital admission during labor, finding that admission in the latent phase was associated with increased use of epidural analgesia and labor augmentation but not with an increase in cesarean sections or adverse neonatal outcomes. This suggests that while CTG can be a useful tool, its timing and context of use are critical for maximizing benefits. In another study, Gupta et al. found that CTG on admission was reassuring in 84.3% of cases, non-reassuring in 11.8%, and pathological in 4.0%. They reported higher incidences of fetal distress, meconium-stained liquor, and NICU stays among patients with pathological patterns, indicating that CTG is effective in identifying fetuses at risk and planning timely interventions to prevent adverse outcomes [11]. Wadhwani et al. concluded that admission CTG is a useful non-invasive tool for predicting adverse fetal outcomes in high-risk pregnancies. Their study showed that CTG could effectively forecast fetal distress, meconium-stained liquor, and NICU admissions, similar to our findings. Paladugu et al. highlighted the role of CTG in predicting immediate postpartum acidemia and its correlation with intrapartum fetal distress. Their findings further support the utility of CTG in identifying fetuses at risk during labor [13]. A study by Sandhu et al. indicated that the admission test cardiotocography (AT-CTG) is beneficial in identifying fetuses at risk for adverse outcomes in high-risk pregnancies. They found that 69.4% of the tests were reactive, 22.2% were equivocal, and 8.4% were pathological. Their findings align with our study, reinforcing CTG's role in guiding interventions to improve neonatal outcomes [14]. In a study by Impey et al., admission CTG was utilized to predict perinatal outcomes. They found that pathological CTG results were strongly associated with adverse neonatal outcomes, including higher rates of cesarean section and NICU admissions. This reinforces our findings on the importance of CTG in identifying high-risk cases early on [16]. In a study conducted by Vintzileos and Smulian, it was noted that decelerations, tachycardia, and decreased variability in CTG were significant indicators of intrapartum fetal hypoxia. They emphasized the importance of continuous CTG monitoring in high-risk pregnancies to detect fetal distress early [17]. Anyaebunam et al. explored the association between umbilical artery cord pH, five-minute Apgar scores, and neonatal outcomes. They concluded that abnormal CTG results were strong predictors of low Apgar scores and adverse neonatal outcomes, aligning with our study findings on the utility of CTG in labor [18]. Gangwar and Chaudhary examined the role of CTG in predicting cesarean sections for fetal distress and its correlation with perinatal outcomes. Their findings supported the use of CTG in early detection of fetal distress, leading to timely cesarean interventions and improved neonatal outcomes [19]. Gupta evaluated the role of CTG in high-risk pregnancies and its correlation with increased cesarean section rates. They found that abnormal CTG results were associated with a higher incidence of cesarean sections and adverse neonatal outcomes, underscoring the importance of CTG in high-risk labor management [20]. In a qualitative study by the IMMO programme, it was highlighted that despite the widespread use of CTG, there are significant challenges in its interpretation and response due to cognitive biases and organizational factors. This study emphasized the need for standardized training and improved clinical protocols to enhance the effectiveness of CTG in labor [21].

Conclusion
The findings of our study underscore the significant role of admission CTG in predicting fetal distress and guiding labor management. The high rate of pathological (ominous) CTG results associated with adverse outcomes such as increased cesarean sections and NICU admissions highlights the utility of CTG in early identification of at-risk fetuses. These results are consistent with other studies, which also report similar associations between CTG patterns and neonatal outcomes. However, the subjective nature of CTG interpretation and the study's limited scope emphasize the need for standardized training and larger-scale research to validate and expand upon these findings. In conclusion, while admission CTG is a valuable tool for assessing fetal well-being during labor, it should be integrated with other clinical assessments and used cautiously, considering its limitations. Standardized interpretation guidelines and technological advancements could enhance its reliability and effectiveness, ultimately improving maternal and neonatal outcomes.

Conflict of Interest
Not available

Financial Support
Not available

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