International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

Prognostic Role of Non-Stress Test (NST) in Antenatal Assessment and Pregnancy Outcome

Dr. Mani Aggarwal[1], **Dr. Veena Aseeja**[2]

[1]Post graduate Resident 3, Department of Obstetrics and Gynaecology, NC Medical College and Hospital, Israna

[2]Professor, Department of Obstetrics and Gynaecology, NC Medical College and Hospital, Israna

Abstract: ***Introduction**: Cardiotocography is widely used for fetal monitoring during labor. The admission Non-Stress Test (NST) helps identify fetuses at risk of distress and guides appropriate monitoring. This study evaluated the role of NST in predicting fetal distress and perinatal outcomes. **Materials and Methods**: Two hundred pregnant women in labor or admitted for safe confinement were divided into two groups-100 underwent admission NST and 100 were monitored by intermittent auscultation. Each group included 50 high-risk and 50 low-risk cases. Outcomes assessed included mode of delivery, APGAR score, and NICU admissions. **Results**: The cesarean section rate was higher in the NST group (38%) compared to the non-NST group (24%). However, NICU admissions were significantly lower among NST patients (14%) than in those without NST (38%). None of the low-risk NST patients required NICU care, while 28% of low-risk non-NST patients did. Babies in the NST group also had higher APGAR scores at birth and at 5 and 10 minutes. **Conclusion**: Admission NST effectively identifies fetuses at risk of distress and is associated with improved neonatal outcomes, though it may increase cesarean deliveries. Routine use of NST at admission can aid in timely intervention and reduce neonatal morbidity.*

Keywords: Cardiotocography, Non-Stress Test, Fetal Distress, APGAR Score, NICU

1. Introduction

The process of labor and the passage of the fetus through the birth canal present a moment of acute stress for the fetus, with implications for mortality and morbidity extending into the subsequent 4-5 decades of life. Recognizing the significance of this period, the need to monitor fetal well-being during labor arose. Early retrospective observational studies initially favored cardiotocography over intermittent auscultation methods, such as using a pinard stethoscope or a handheld doppler ultrasound device [1]. Its application expanded swiftly from high-risk to low-risk pregnancies, where the fetus faced minimal risk from hypoxic events during labor. Despite its popularity in monitoring fetal conditions, cardiotocography has consistently correlated with increased obstetric interventions, including labor augmentation, epidural anesthesia, instrumental delivery, and cesarean section [2]. National consensus statements have suggested that the choice between electronic monitoring and auscultation should align with risk status and individual preferences [3].

Intermittent auscultation emerges as a suitable method for lowrisk women in labor, striking a balance between ensuring fetal safety and permitting maternal mobility. However, successful auscultation requires frequent monitoring, particularly in the second stage of labor. In the presence of identified problems or high maternal risk, electronic fetal monitoring becomes the recommended approach. The introduction of admission cardiotocography aimed to identify at-risk fetuses, enabling closer monitoring for those requiring it, while low-risk cases could still undergo intermittent auscultation [4]. Some studies suggest that admission cardiotocography has a similar impact on low-risk women, albeit with a significant increase in intervention rates and no discernible effect on neonatal outcomes [5]. Clinical experience has perpetuated concerns about fetal heart rate changes, although some have been proven to be physiological variations within the normal range [6].

In our study involving 200 patients, we investigated the role of non-stress tests (NST) as an admission test and its outcomes concerning the prediction of fetal distress, mode of delivery, APGAR score of the newborn, and the need for the baby's NICU admission. Additionally, we have compared these outcomes with cases where an admission test was not conducted.

2. Material and Methods

The research was carrid out at a tertiary care center over 18 months, involving a cohort of 200 randomly selected registered Antenatal Care (ANC) patients. These 200 patients, either in labor or admitted for safe confinement, were divided into two groups, each comprising 100 patients. The first group included 50 high-risk and 50 low-risk cases, and they did not undergo a Non-Stress Test (NST) on admission, regardless of their risk status (Table 1).

Table 1: Table showing the distribution of high-risk cases in both the groups

Type of Patient	Non-NST Group	NST Group
Postdatism	12	8
Oligohydramnios	10	12
PROM	6	8
Anemia	2	2
PIH	4	8
Rh negative	4	2
Breech	4	4
Previous LSCS	6	6
Twins	2	–
Total Patients	50	50

Instead, they were monitored using the intermittent auscultatory method. The second group also comprised 50 high-risk and 50 low-risk patients, but in this case, they underwent NST on admission, irrespective of their risk level. Before participation, patients were informed about the study's

nature and potential outcomes, and written valid informed consent was obtained from those willing to participate.

Continuous tocography and monitoring

Continuous tocography, encompassing the monitoring of fetal heart rate during both the antepartum and intrapartum periods, was conducted. This included stress and non-stress tests, along with the continuous beat-to-beat recording of the instantaneous heart rate synchronized with the pressure changes resulting from uterine contractions. All participants in the study fell within the age group of 18- 30 years.

Age group and selection criteria

The selection criteria for high-risk cases included risks stemming from maternal medical problems such as hypertension, diabetes, severe anemia, cyanotic heart disease, hyperthyroidism, and renal disease. Additionally, risks arising from fetal conditions, including intrauterine growth retardation, post-term pregnancy, preterm delivery, oligohydramnios, multiple pregnancies, breech presentation, and Rhesus isoimmunization, were considered. Problems related to labor, such as induced labor, prolonged rupture of membranes, previous Lower Segment Cesarean Section (LSCS), and vaginal bleeding during labor, were also indicative of high risk. Suspected fetal distress in labor, particularly in the presence of meconium-stained amniotic fluid, further classified cases as high risk. On the other hand, low-risk cases were characterized by full-term pregnancies, spontaneous onset of labor, the absence of maternal medical illnesses, and no demonstrable fetal risks. A comprehensive approach was adopted, involving a detailed history, clinical examination, and the completion of routine and specific Antenatal Care (ANC) investigations for all participants.

Technique and method of recording

Before the procedure, patients were instructed to empty their bladder. During the procedure, patients were positioned on a couch with a 15-degree left lateral tilt. The fetal heart rate recorder was placed where the fetal heart was best heard, and an echogel was used as an interface between the abdominal wall and transducer. The transducer was then strapped to the maternal abdomen. The recording duration was a minimum of 20 min or until at least 2e3 contractions were identified. The interpretation of FHR tracings was done according to the Criteria of Hon & Quilligan [8], which included studying the baseline fetal heart rate, beatto-beat variability, and periodic changes. Finally, the tracings were recorded and studied.

Criteria for NST

The criteria for a reactive Non-Stress Test (NST) involve specific parameters to assess fetal wellbeing. A reactive NST is characterized by a baseline fetal heart rate (FHR) ranging between 110 and 160 beats per minute (bpm), good beat-to-beat variability within 7e8 bpm, a minimum of two accelerations exceeding 15 bpm, and lasting more than 15 s, and the absence of decelerations over 20 min. In the case of a reactive NST, monitoring is repeated every 3 h until delivery, with intermittent auscultatory monitors used between two consecutive NSTs. Conversely, non-reactive NST criteria include a baseline FHR below 110 bpm or above 160 bpm, beat-to-beat variability less than 5 bpm, no accelerations, and the presence of significant decelerations over the 20-min monitoring period. Equivocal NST criteria involve a baseline FHR below 100 bpm or above 160 bpm, absent beat-tobeat variability, no accelerations, and no decelerations observed over the 20 min. These criteria serve as essential indicators for assessing fetal wellbeing during pregnancy.

Management of equivocal NST

In instances of equivocal Non-Stress Test (NST) results, a strategic approach was employed to enhance fetal well-being. Patients exhibiting equivocal NST underwent interventions including positioning the patient in the left lateral position, providing maternal oxygen, and administering rapid intravenous hydration. Following these measures, a repeated NST was conducted after 30 min, with subsequent analysis of the tracings. If the NST results remained equivocal, surgical intervention was considered based on findings from per vaginal examination.

Monitoring in the absence of NST

For patients who did not undergo NST on admission, fetal heart rate monitoring was performed using a handheld Doppler device. This alternative monitoring method aimed to assess fetal well-being in the absence of NST results.

3. Results

The study encompassed a total of 200 cases, with 100 patients undergoing a Non-Stress Test (NST) and an equivalent number of 100 patients not undergoing NST. The distribution of high-risk cases within both groups demonstrated comparability, ensuring a balanced representation of high-risk scenarios across the NST and non-NST cohorts. This careful balance in high-risk case distribution contributes to the reliability of the study's findings, allowing for meaningful comparisons between the outcomes of patients who underwent NST and those who did not. Such a methodical approach to case inclusion and risk distribution enhances the study's ability to discern the impact of NST on maternal and fetal well-being, providing valuable insights into the effectiveness of this monitoring method in varied risk situations.

Mode of delivery

Among the 50 low-risk patients who did not undergo the Non-Stress Test (NST), a majority of 36 experienced normal deliveries, indicating a favorable outcome for most of this subgroup. Additionally, 6 low-risk patients underwent cesarean sections, while 8 opted for instrumental delivery. This diversity in delivery methods suggests varied obstetric interventions based on individual patient needs and clinical considerations within the low risk category

Similarly, within the high-risk patient group of 50 individuals who did not undergo NST, the outcomes exhibited a range of delivery methods. Specifically, 24 high-risk patients underwent normal deliveries, underscoring successful outcomes for a significant proportion. Conversely, 18 high-risk patients required cesarean sections, highlighting the need for increased medical intervention due to the higher-risk nature of this subgroup. Additionally, 8 high-risk patients underwent instrumental deliveries, demonstrating the complexity and individualized approach taken in managing deliveries within the high-risk category (Table 2). The distribution of delivery methods in both low and highrisk

subgroups provides valuable insights into the obstetric management strategies employed in the absence of NST monitoring (Fig.2).

Table 2: The following table compares the mode of delivery in the low- risk and high risk groups in the control and study group

Mode of Delivery	Non NST Group		NST Done	
	LR	HR	LR	HR
Vaginal	36	24	46	12
Caesarean	6	18	2	36
Instrument	8	8	2	2
Total	50	50	50	50

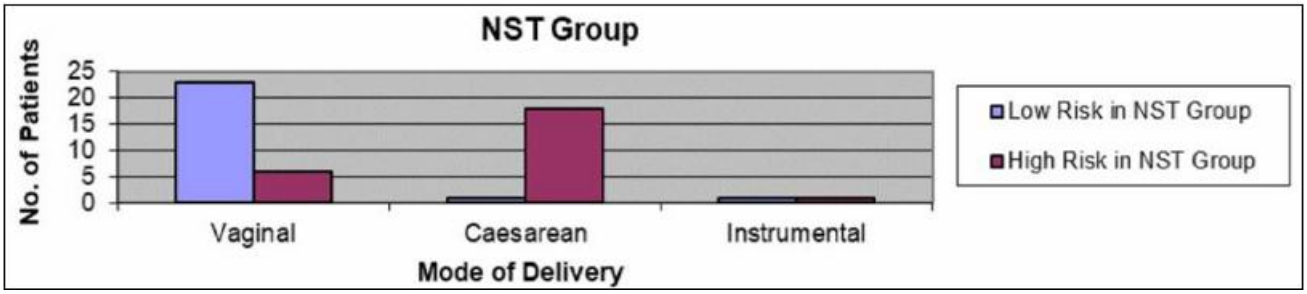

Figure 1: The mode of delivery in the low risk and high risk NST groups

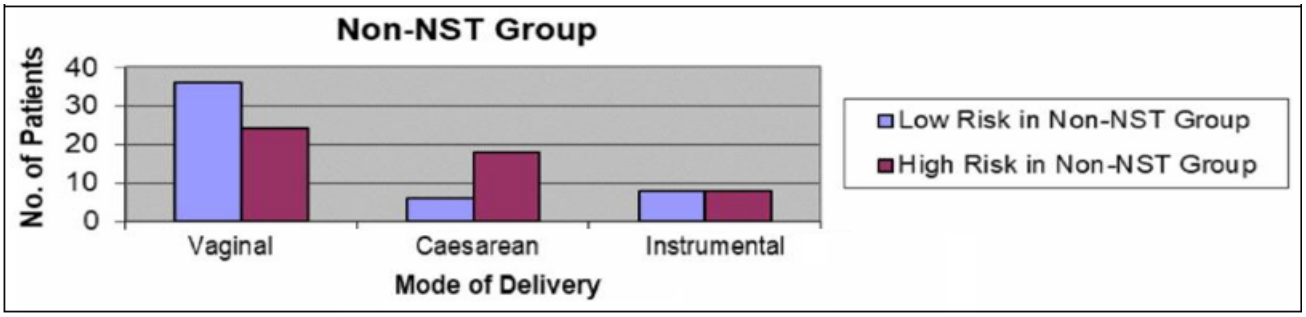

Figure 2: The mode of delivery in the low risk and high risk non- NST groups

Among the 50 low-risk patients who underwent Non-Stress Test (NST), a significant majority of 46 experienced normal deliveries, indicating a positive and uncomplicated outcome for most of this low risk subgroup. In contrast, a minimal number of 2 low-risk patients required cesarean sections, suggesting a low incidence of interventions in this subgroup. Similarly, 2 low-risk patients opted for instrumental delivery, further highlighting the overall favorable outcomes, and limited obstetric interventions in the low-risk category with NST monitoring.

Conversely, within the high-risk patient group of 50 individuals who underwent NST, the outcomes displayed a different pattern. Specifically, 12 high risk patients had normal deliveries, underscoring successful outcomes for a proportion of this high risk subgroup. However, a significant number of 36 high-risk patients required cesarean sections, emphasizing the increased need for medical intervention in the high-risk category despite NST monitoring. Additionally, 2 high-risk patients underwent instrumental deliveries, providing insights into the complexity and individualized approach in managing deliveries within the high-risk category with the aid of NST monitoring. Overall, the distribution of delivery methods in both low and highrisk subgroups with NST monitoring highlights the varying obstetric management strategies based on the risk profile of the patients (Fig.1).

Among the 100 patients who underwent NonStress Test (NST), the results revealed that 60 % of them had reactive NST, indicating a reassuring fetal status. Within this subgroup, a substantial 83 % underwent vaginal delivery, affirming the favorable outcomes associated with a reactive NST. Additionally, 13 % of patients with reactive NST delivered via cesarean section, and 3.3 % had instrumental deliveries, showcasing the diverse obstetric management approaches within this subgroup (Table 3).

Table 3: The following table compares the result of the admission test and the mode of delivery

NST tracing	Vaginal Delivery	Cesarean Section	Instrumental
Reactive (60%)	50	8	2
Non- Reactive (18%)	-	18	–
Equivocal (22%)	8	12	2
Total	58	38	4

In contrast, 18 % of patients exhibited non-reactive NST results, signaling potential concerns about fetal well-being. Notably, all these patients, accounting for 100 %, underwent delivery via cesarean section, underlining the association between nonreactive NST and an increased likelihood of requiring cesarean intervention.

Furthermore, 22 % of patients demonstrated equivocal NST results, indicating an indeterminate fetal status. Within this subgroup, 36.36 % experienced vaginal deliveries, emphasizing that a portion of patients with equivocal NST outcomes had positive delivery outcomes. However, a substantial 54.5 % underwent cesarean section, and 9 % had instrumental deliveries, illustrating the complexity and varied

outcomes associated with equivocal NST results. Overall, the distribution of delivery methods among patients with different NST outcomes highlights the critical role of NST in guiding obstetric decision-making based on fetal monitoring results.

NICU admissions

The comparison between the Non-Stress Test (NST) group, encompassing both low-risk and highrisk cases, and the group without NST revealed notable differences in the neonatal outcomes, particularly regarding the need for Neonatal Intensive Care Unit (NICU) care (Table 4). In the nonNST group, comprising patients who did not undergo NST, a significant proportion, accounting for 38 % (38 babies), required NICU care. This suggests that neonates in this group faced a higher likelihood of encountering health challenges requiring specialized care and attention.

Conversely, in the NST group, which includes both low-risk and high-risk cases, a comparatively lower percentage, specifically 14 % (14 babies), needed NICU care (Table 5). The implementation of NST as part of fetal monitoring appears to be associated with a reduced incidence of neonatal complications that necessitate intensive care. This finding underscores the potential benefits of incorporating NST into antenatal care, as it may contribute to better neonatal outcomes and a decreased demand for intensive medical interventions in the postnatal period.

Table 4: The following table shows the number of babies admitted to NICU in Non- NST group patients

Group type 100 Patients	NCU admission
Low Risk	12
High Risk	26
Total	38 (38%)

Table 5: The following table shows the number of babies admitted to NICU in NST group patients

Group type 100 Patients	NCU admission
Low Risk	-
High Risk	14
Total	14 (14%)

APGAR scoring

The presented table (Table 6) indicates a notable difference in the APGAR scores at birth, after 5 min, and after 10 min between the NST (Non-Stress Test) group and the non-NST group. Babies in the NST group exhibited relatively higher APGAR scores, suggesting better overall neonatal well-being immediately after birth and during the subsequent minutes of observation.

Table 6: The following table shows APGAR at birth, after 5 min, and after 10 min in non- NST and NST groups.

	APGAR	Non. NST Group	NST Group
At Birth	5- 7	26	20
	8- 10	64	82
At 5 Min.	5- 7	18	8
	8- 10	72	94
At 10 Min	5- 7	4	2
	8- 10	86	100

After comparing the two groups, it is clear that infants in the NST group had a better APGAR score at birth, indicating higher physiological well-being and adaptation to the outside world. This initial assessment is crucial in gauging the newborn's immediate response to the birthing process and their ability to establish vital functions independently.

Furthermore, the trend of higher APGAR scores in the NST group persisted at the 5-min mark, reinforcing the notion that these newborns continued to demonstrate robust physiological parameters, such as heart rate, respiratory effort, muscle tone, reflex response, and color. The sustained elevated scores currently point suggest a positive trajectory in the early neonatal period. The positive trend extended to the 10-min assessment, with babies in the NST group maintaining comparatively higher APGAR scores. This sustained resilience and adaptability are indicative of a favorable birthing experience and immediate postnatal transition for infants subjected to NST monitoring. Overall, the data suggests a potential correlation between NST utilization and improved neonatal well-being, as reflected in consistently higher APGAR scores across the evaluated time points.

Sensitivity and specificity of the NST test

Table No.8 underscores a crucial observation that no single aspect of fetal heart rate can universally pinpoint all instances of fetal asphyxia. One of the most significant indicators is the presence of contractions, particularly when accompanied by a lag phase. This scenario, coupled with baseline tachycardia and deceleration with alterations in beat-tobeat variability, serves as a reliable marker of fetal distress. The interaction of these elements during contractions provides valuable insights into the well-being of the fetus. Conversely, when fetal heart rate exhibits no variation during contractions, it strongly suggests that the fetus is adequately compensated, and there is no indication of asphyxia. This lack of change in heart rate under such circumstances signifies a state of equilibrium and effective fetal adaptation to the stresses imposed by contractions.

Table 8: Shows the relation between baseline FHR, Variability, Periodic Changes and Mode of Delivery

	Vaginal Delivery	Cesarean Section	Instrumental
Baseline FHR			
Normal FHR	50	8	2
Bradycardia	4	10	–
Tachycardia	4	20	2
Variability			
Silent	6	14	2
Narrowed	6	14	–
Indulatory	26	4	2
Saltatory	20	4	–
Periodic Changes			
No Change Pattern	8	–	2
Acceleration Pattern	50	6	2
Early Deceleration	–	2	–
Variable Deceleration	–	20	–
Late Deceleration	–	10	–

The presence of baseline bradycardia without deceleration but with good beat-to-beat variation typically points away from asphyxia. This specific pattern suggests that despite the baseline bradycardia, the fetus is managing well, and there is

no imminent threat of oxygen deprivation. Furthermore, a baseline tachycardia accompanied by good beat-to-beat variability, coupled with a consistent rate during contractions, is a rare scenario associated with fetal asphyxia. This observation underscores the complexity of fetal heart rate patterns and emphasizes the need for a comprehensive analysis, considering multiple parameters. Overall, these insights contribute to a nuanced understanding of fetal well-being during labor, aiding in timely interventions and informed decision-making for optimal maternal and neonatal outcomes.

4. Discussion

A nonstress test is a good indicator of fetal wellbeing for 80 % of fetuses who go through labor without any problems. Surveillance during labor and access to substantially greater information using an electronic fetal monitor is far superior to that obtained by conventional means.

Although the percentage of cesarean rate in both our groups was more than in the study reported by Leveno et al., there was a good perinatal outcome which was observed in our group of patients. The percentage of reactive NST in our study was 60 %, whereas in a study by Manning et al., and Barrets et al. the percentage of reactive tests in various series ranged from 78 to 95 %. Similarly, 10 % of reactive patterns were associated with instrumental deliveries as compared to 16 % with abnormal patterns.

In our study, 50 % of reactive patterns had normal vaginal delivery as compared to 8 % with abnormal patterns. While only 2 % of reactive as well as abnormal patterns had instrumental deliveries. Intermittent auscultation has been assessed against external fetal monitoring in several studies and the outcome were, that external fetal monitoring reduced the incidence of perinatal mortality.

In our study, it was observed that amongst the non-NST group patients, 12 babies of low-risk mothers and 26 babies of high-risk mothers were transferred to NICU i. e.38 (38 %) (Fig.4). Amongst the NST group patients, only 14 babies of high-risk mothers were transferred to NICU i. e.14 (14 %) (Fig.5). This shows that the incidence of NICU admission of the babies increased with the risk factor in the mother.

In our study the incidence of NICU admission of babies was high in non-NT group patients as compared to patients in whom NST was done. Dastur et al. in 1982, in their study concluded that perinatal outcome was good following antepartum monitoring with NST. Although admission tests showed abnormal tracing, there was a good perinatal outcome, thereby the chances of morbidity and mortality were reduced.

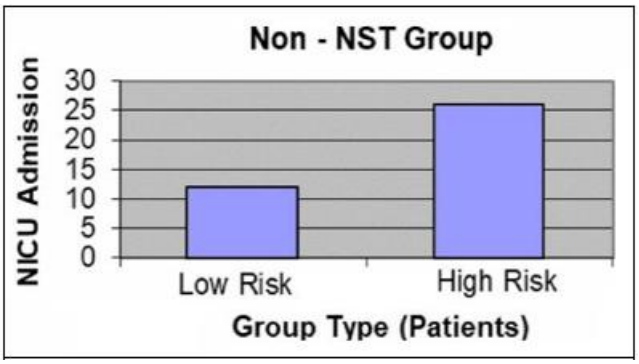

Figure 4: NICU admission of low risk and high risk in Non-NST group patients

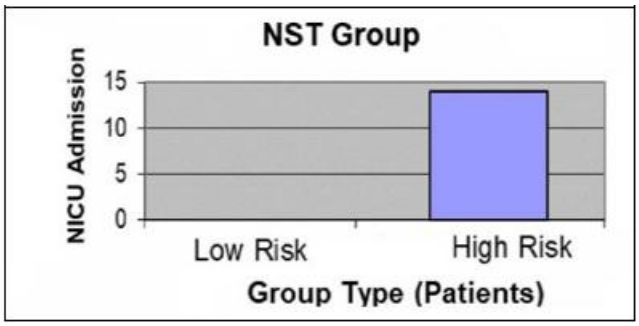

Figure 5: NICU admission of low risk and high risk in NST group patients

The sensitivity of the test i. e. ability to detect true positives was low but was comparable to the study done by Ingemarrson. Specificity of the test i. e. ability to correctly identify those who were not at risk for fetal distress i. e. true negatives were high, so also was observed by A. Hegde et al., Ingemerrson et al. Sensitivity to NST in most series ranges from 21 to 57 %. The value of 21 % in the present study compares favorably. The specificity of 91 % in present study also compares favorably to 82- 94 % reported. The positive predictive value is on the lower side, the negative predictive value of 62 % is on the lower side of the values from 73 to 98 % reported in other series (Table 7). Many times, early uterine contractions may serve as functional stress to the fetus, an admission test might detect fetal intrauterine asphyxia already present on admission and might have some predictive value for asphyxia that may develop during labor.

Table 7: This table shows the Sensitivity and Specificity of the NST test

Sensitivity	21%
Specificity	91%
+ve predictive value	8%
-ve predictive value	62%

5. Conclusion

Antepartum or intrapartum fetal heart monitoring with a nonstress test as the primary means of surveillance is a reliable diagnostic approach. Nonreactive tests are associated with a statistically significant increase in cesarean rate. In our study of 200 patients, it was observed that in NST-done patients the rate of cesarean delivery was higher than in non-done group patients, but there was a significant reduction in the number of babies who were taken to NICU, in the NST-done group (Table 9).

Table 9: LSCS rates

	Non. NST Group	NST Group
Leveno et. al. in 690 cases	6%	18%
Present Study	24%	38%

In monitored patients, the stage of labor, fetal heart patterns, and their period changes in uterine contractions were co-related. It was found that fetal heart rate tracings showing moderate to severe late decelerations, prolonged variable decelerations, and silent pattern were all the warning signs of fetal compromise in utero and these signs demanded prompt action, in the form of corrective measures or operative intervention. Fetal heart rate monitoring has also allowed us to let labor progress normally in many patients who could have otherwise had a cesarean section due to other risk factors. In conclusion, this study has proved the value of fetal heart rate monitoring for a favorable outcome of a healthy baby with good APGAR at birth.

References

[1] Royal College of Obstetrics and Gynaecology. Evidence based Clinical Guideline number 8. The use of electronic fetal monitoring: the use and interpretation of cardiotocography in intrapartum fetal surveillance. London: RCOG press; 2001. p.52.
[2] Thacker SB, Stroup D, Chang M. Continous electronic heart rate monitoring for fetal assessment during labour (Cochrane review). The cochrane library, issue 4. Oxford: Update Software; 2001.
[3] Spencer JAD, Ward RHT. Recommendations arising from the 26th royal College of obstetrics and gynaecology study group: intrapartum fetal surveillance. In: Spencer JAD, Ward RHT, editors. Intrapartum fetal surveillance. London: Royal College Of Obstetricians and Gynaecologists press; 1933. p.387-93.
[4] Ingemarsson I. Electronic fetal monitoring as a screening test. In: Spencer JAD, Ward RHT, editors. Intrapartum fetal surveillance. London: Royal College Of Obstetrician and Gynaecologists press; 1993. p.45-52.
[5] Mires G, Williams F, Howie P. Randomised controlled trial of Cardiotocography versus Doppler auscultation of fetal heart at admission in labour in low risk obstetric population. BMJ 2001 June 16; 322: 1457-62.
[6] Spencer JA, Johnson P. Fetal heart rate variability changes and fetal behavioral cycles during labour. Br J Obstet Gynecol 1986 Apr; 93 (4): 314-21.
[7] Steer PJ, Danielian P. Fetal distress in labour. In: James DK, Steer P, Weiner CP, Gonik B, editors. High risk pregnancy management options.2nd ed. London: WB Saunders; 1999. p.1121-49.
[8] Hon EH. An Atlas of fetal heart rate patterns. New Haven, USA: Harty press; 1968.
[9] American college of Obstetrics & Gynecology. Fetal heart rate patterns; monitoring, interpretation & management. ACOG technical Bulletin. No 207. July 1995 Int J Gynecol Obstet 1995; 51: 65-74.
[10] Society of Obstetrics & Gynecologists of Canada. Fetal heart surveillance in labour. Executive summary Ottawa: SOGC. SOGC policy statement; 1995. p.41.