International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Nagpal A et al. Int J Reprod Contracept Obstet Gynecol. 2023 Jun;12(6):1660-1665
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20231532

Original Research Article

Predictive value of admission and intrapartum cardiotocography in normal and high risk antenatal women

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Received: 29 March 2023
Revised: 11 May 2023
Accepted: 12 May 2023

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ABSTRACT

Background: Cardiotocography is the most common method for assessing fetal health and reveals brain oxygenation. This study is done for admission and intrapartum cardiotocography in high- and low-risk pregnancies and its correlation with neonatal outcome.
Methods: All high-risk and normal antenatal women with more than 34 weeks of pregnancy and vertex presentation who came to the labor room were included in the study. 200 cases were taken, 100 were in the "high risk group," and the remaining 100 were in the "low risk group." On admission CTG and intrapartum CTG tracing were taken after written and informed consent, neonatal outcomes were observed, and adverse neonatal outcomes were noted.
Results: Admission CTG results were unsatisfactory for 9% of women in the high-risk group and none in the low-risk group**.** Intrapartum NST was non reassuring in 51% of high-risk women and 6% of the low-risk group. Of the total number of neonates admitted to the NICU, 14 were from the low-risk group, while 50 were from the high-risk group.
Conclusions: On admission NST in both low and high-risk women, the absence of category III NST predicted the absence of an adverse neonatal outcome most accurately. Even during labor in both high-risk and low-risk women, the absence of category III reassured the fetal well-being most precisely.

Keywords: Admission CTG, Intrapartum CTG, Neonatal outcome

INTRODUCTION

Cardiotocography is the most common method for assessing fetal health and reveals brain oxygenation. It is predicated that the heart rate of a non-acidotic, non-impaired foetus would briefly increase in reaction to foetal movement. The antepartum assessment of fetal wellbeing has become an integral part of the management of both high risk and low risk pregnancies.[1]

The development and perfection of specific and accurate diagnostic tests for identification of the fetus at risk in uterus have long been a major challenge for obstetricians since more than 75% of the fetal deaths occurs during antepartum period, focus has shifted from limiting fetal surveillance to the intrapartum period to also the antepartum period.[2] Though there are many antepartum biophysical monitoring methods like Contraction Stress Test (CST), Non Stress Test (NST), fetal biophysical profile, vibracoustic fetal stimulation, amniotic fluid volume assessment, doppler velocimetry for high risk pregnancies, there is no single test which is ideal for all high risk fetuses.[3,4] These techniques aim to identify fetuses that are at risk of preventable morbidity or mortality from utero-placental insufficiency due to maternal risk factors, placental disorders, or fetal disease.

It is believed that heart rate reactivity is a reliable indicator of proper autonomic function in embryos. Consequently, pathological loss of acceleration may also be accompanied

by drastically decreased beat-to-beat variability and heart rate in fetuses. The primary rationale for admission CTG is that placental circulation is stressed during labour, and an aberrant tracing indicates a deficit, allowing for the early detection of foetal impairment and subsequent intervention. NST can identify the fetus in jeopardy in the compromised intrauterine environment and also fetus that may not be able to tolerate the stress of labor. This is indicated by non-reassuring fetal heart rate (FHR) patterns.[5,6]

Hence, the admission CTG might have a dual purpose. It can be used as a screening tool during the first stages of labour to identify women who will benefit from continuous electronic foetal monitoring and to identify fetuses who are compromised upon admission.[7] Intrapartum monitoring is performed to identify foetal hypoxia as soon as feasible, hence reducing the risk of acidosis and eventual brain impairment.

METHODS

A prospective observational study was conducted on antenatal women of more than 34 weeks gestation and cephalic presentation admitted to the labor room. The study was conducted at Subharti Medical College, Meerut from October 2020 till August 2022. Of all the cases, 100 high-risk pregnancies and 100 low risk pregnancies were enrolled in the study. Written consent as well as informed consent was obtained from all the women fulfilling the inclusion criteria. On the study protocol, clinical information (history and examination findings) was recorded, and the admission CTG (as stated in the introduction) was performed for 20 minutes.

Based on the results of the CTG, the laboring woman was treated according to the regular departmental guidelines. The neonatal outcomes were recorded in NICU admission.

Inclusion criteria

Inclusion criteria were all pregnancies with >34 weeks gestation; singleton pregnancies; cephalic presentation; both high- and low-risk pregnancies.

Exclusion criteria

Exclusion criteria were pregnancies <34 weeks gestation; anomalous babies; preterm labor; IUFD; multifoetal pregnancy, malpresentations, and intrauterine death.

CTG was done at the time of admission and during the intrapartum period for every woman participating in this study, and it was interpreted according to FIGO (The International Federation of Gynecology and Obstetrics) CTG classification (2015).[8]

Details of labor, including duration of labor, mode of delivery, etc., were noted. The presence of meconium stained liquor was noted. At birth, the baby's APGAR score at 1 and 5 minutes was given by the attending pediatrician. Birth weights were noted. Cord blood pH was sent. A follow-up of the baby was taken in regards to the need for admission, the NICU stay, oxygen support, the need for a ventilator and ionotropes, and neonatal mortality.

Statistical analysis

The statistical analysis was performed using the statistical software for the social science system, version 17.0 SPSS. If the data were not uniformly distributed, continuous variables were reported as the mean (SD) or median. Categorical variables were reported as frequencies and percentages. In all statistical tests, a p-value less than 0.05 were considered to indicate a statistically significant difference.

RESULTS

This study was conducted on 200 women. On evaluating the demographics of the two groups, it was found that in both, the majority of women were in the age group 20–29 years (79 % vs. 72 %). Forty percent were graduates or post-graduates in the low-risk group, whereas thirty-seven percent had received primary education in the high-risk group (Table 1). The difference in demographics between the two groups was found to be statistically insignificant.

Table 1: Demographic representation of study groups.

		Low-risk group (%)	high-risk group (%)
Age groups (years)	20-29	79 (79)	72 (72)
	30-39	20 (20)	25 (25)
	>39	1 (1)	3 (3)
Education	Illiterate	6 (6)	4 (4)
	Primary education	36 (36)	37 (37)
	Secondary education	18 (18)	24 (24)
	Graduate or postgraduate	40 (40)	35 (35)
Residence	Rural	44 (44)	42 (42)
	Urban	56 (56)	58 (58)
Religion	Hindu	73 (73)	76 (76)
	Muslim	20 (20)	21 (21)
	Others	7 (7)	3 (3)
Socio-economic status	Upper	9 (9)	11 (11)
	Upper middle	33 (33)	29 (29)
	Lower middle	49 (49)	54 (54)
	Upper lower	5 (5)	5 (5)
	Lower	4 (4)	1 (1)
Gravida	Primigravida	30 (30)	40 (40)
	Multigravida	70 (70)	60 (60)

Among the women included in the "high risk" group, the risk factors reported were anemia (34%), previous LSCS (21%), postdated (6%), oligohydroaminos (5%), hypertensive disorders of pregnancy (19%), antepartum hemorrhage (6%), and cholestasis of pregnancy (4%) (Figure 1).

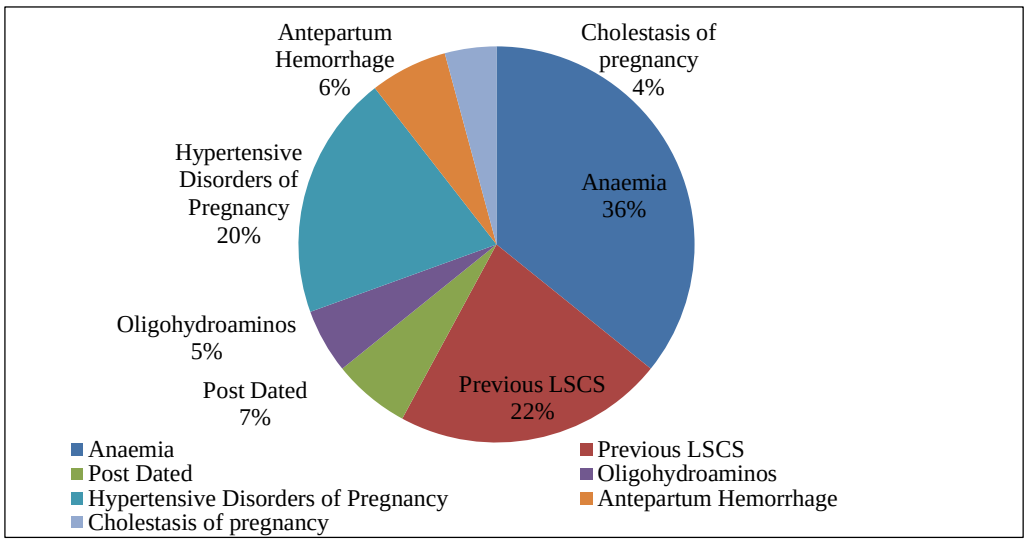

Figure 1: Distribution of high risk factors in the "high risk group.

In the two groups, women who delivered fetuses with meconium-stained liquid, had low cord blood pH, a low 1 minute and 5-minute Apgar score, or required NICU admission were categorized as having an adverse neonatal outcome for further analysis.

In the low-risk group, thirty neonates, and in the high-risk group, sixty-six neonates, had adverse neonatal outcomes (Table 2).

This given table 3 suggests sensitivity, specificity, positive predictive value, and negative predictive value with admission NST in both the low and high risk groups (Table 3).

This given Table 4 suggests values for sensitivity, specificity, positive predictive value, and negative predictive value with intrapartum NST in both low and high risk groups (Table 4).

Table 2: Total number of adverse neonatal outcome in low and high risk groups according to admission NST and intrapartum NST.

	NST findings	Low-risk group	High-risk group
Admission NST	Category I	21	12
	Category II	9	45
	Category III	0	9
Total		30	66
Intrapartum NST	Category I	20	7
	Category II	5	17
	Category III	5	42
Total		30	66

Table 3: Sensitivity, specificity, predictive values during admission NST for adverse neonatal outcome in low and high risk.

			Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Admission NST	**Low-risk group**	CAT-1	25	43.7	70	10
		CAT-2	56.2	75	30	90
		CAT-3	0	70	0	100
	High risk group	CAT-1	36.3	19.4	18.1	38.3
		CAT-2	77.5	50	68.18	61.7
		CAT-3	90	36.6	14.06	97.05

For detecting adverse neonatal outcomes in low risk groups, admission NST category I had a PPV of 70% but a low sensitivity of 25%; category II NST on admission had a high NPV of 90%, whereas category III NST had a

100% NPV in low-risk women. During labor, category III NST had the highest sensitivity (83%), and the highest NPV (98.5%). Also, category I NST had the highest PPV of 67%. In the high-risk group, admission NST category III had the highest sensitivity of 90%, followed by category II with a sensitivity of 77.5%. Category III NST also had the highest NPV of 97%.

Table 4: Sensitivity, specificity, predictive values during intrapartum NST for adverse neonatal outcome in low and high risk.

			Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Intra partum NST	Low-risk risk group	CAT-1	24.6	47.3	66.6	12.8
		CAT-2	38.4	71.2	16.6	88.5
		CAT-3	83.3	74.4	17.2	98.5
	High risk group	CAT-1	31.8	24.3	10.6	55.8
		CAT-2	62.7	32.8	25.7	70.5
		CAT-3	82.3	51	63.6	73.5

Table 5: Indication for NICU admission in two groups.

Indication of NICU admission	Low risk group (%)	High risk group (%)	Total (%)
Meconium stained liqor	1 (7.14)	21 (42)	22 (34.3)
Respiratory distress	6 (42.8)	8 (16)	14 (21.8)
Low APGAR	2 (14.2)	13 (26)	15 (23.4)
CPR/ventilator support	0 (0)	3 (6)	3 (4.6)

Table 5 shows that meconium stained liqor (34.3%) was most common indication for NICU admission. Meconium stained liqor (34.3%) and Low APGAR score (23.4%) were significantly more among neonates of high-risk group. Three neonates (4.6%) who required CPR/ ventilator support also belong to high-risk group. Respiratory distress was seen in 21.8% of neonates.

DISCUSSION

In an effort to lower perinatal mortality and morbidity, electronic foetal monitoring for intrapartum foetal surveillance has become more common in recent years. According to Schifrin et al, it is thought to be a better tool for detecting foetal hypoxia because it picks up on the tiny variations in foetal heart rate that intermittent stethoscope auscultation might miss.[9]

In present study, LSCS deliveries were significantly more among high risk group whereas vaginal births were significantly more among low risk group. Faruqi et al, reported that the mode of delivery in the abnormal NST group, 90% of the women had caesarean section, 9% had normal vaginal delivery and only 1% had instrumental vaginal delivery whereas 90% had normal vaginal delivery, 7% had caesarean section and only 3% had instrumental delivery in normal NST group.[10]

In this study, Category I (reactive) was significantly more among low risk group whereas Category II (equivocal) and Category III (non-reassuring) was significantly more among high risk group.

Nandmer et al, observed that cardiotocography traces were divided into reassuring and abnormal as per NICE Criteria 2017 and 65.6% women had reassuring CTG and 34.4% had abnormal pattern.[11] Mires et al reported 21.8% of the admission traces to be normal, while 3.6% were considered as abnormal.[12] Rajalekshmi et al studied on 400 women, out of which 267 (66.75 %) had reactive tracing, 133 (33.25%) had abnormal tracings, respectively.[13] In study by Dhanalakshmi et al, 60.1% women had reassuring CTG, 33.4% belonged to non-reactive group and 6.5% belonged to ominous.[14]

In present study, LSCS deliveries were significantly more among high risk group whereas vaginal births were significantly more among low risk group. Faruqi et al, reported that the mode of delivery in the abnormal NST group, 90% of the women had caesarean section, 9% had normal vaginal delivery and only 1% had instrumental vaginal delivery whereas 90% had normal vaginal delivery, 7% had caesarean section and only 3% had instrumental delivery in normal NST group.[10]

Rahman et al found that incidence of neonates getting admitted in ICU was highest in patients with ominous admission test (62%), compared to those with reactive (3.5%) and equivocal admission test (27.8%).[15] Similar rates of NICU admission are reported by Perveen et al that is, 66.67% NICU admission in ominous group and 6.6% in reactive group.[16]

Nandmer et al observed that 44.6% neonates with abnormal trace had NICU admission.[11] In the high risk

versus low-risk group, NICU admission was present in 55.3% versus 46.15%, and 44.6% versus 53.8% of neonates with in abnormal and reassuring, respectively.

In current study, NICU stay was significantly more among CAT-III .The mean NICU stay was significantly more among CAT-III compared to CAT-I and CAT-II. Grunting and LBW was significantly more among CAT-III.

Categories I and II of admission NST showed a high NPV of 90% and 100%, respectively, but category III NST had a low sensitivity for identifying adverse newborn outcomes in low risk mothers. Admission NST category III showed the best sensitivity (90%) for identifying an unfavorable neonatal outcome in the high-risk group, followed by category II (77.5% sensitivity) and category I (36.5% sensitivity).

Bera et al found that the sensitivity of admission CTG to detect intrapartum fetal distress is 84.13%, specificity is 67.52%, positive predictive value is 58.24%, and negative predictive value is 88.76%.[17]

Rahman et al found that noted high specificity (91%) of the admission test.[15] Ingemarsson et al, also reported a very high 99.4% specificity in their studies.[18] The high specificity of the AT means that a normal test accurately excludes adverse fetal status at the time of testing. Kushtagi et al found low sensitivity and PPV of 53% and 61%, and high specificity and NPV of 93% and 91%, respectively.[19] Ducey et al got best PPV (75%) in their results, sensitivity and specificity was 57% and 98%, respectively.[20]

CONCLUSION

Predicting a baby's health and wellbeing with CTG is possible. In high-risk pregnancy, it is more useful since its sensitivity, specificity, and positive predictive value (PPV) are all higher, and its p value is less than 0.001. On admission NST as well as intrapartum NST in both low- and high-risk women, the absence of category III NST predicted the absence of an adverse neonatal outcome most accurately.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Nagpal A, Tyagi M, Gupta S, Gupta M. Predictive value of admission and intrapartum cardiotocography in normal and high risk antenatal women. Int J Reprod Contracept Obstet Gynecol 2023;12:1660-5.