The Accuracy of Intermittent Fetal Monitoring in Detection of Fetal Distress in Low Resource Settings: A Cross-Sectional Observational Study

Marwan Osama Elkady [1]; Ahmed Abdel Kader Saad Eldin Fahmy [2]; Nada Ahmed Mohamed Ghozzy [3]; Bassem Aly Islam [1]
Obstetrics & Gynecology Department, Faculty of Medicine - Ain Shams University

Abstract

Background: Monitoring the fetus during pregnancy and labor is crucial to ensure the safe delivery of a healthy baby with minimal intervention. Abnormalities in the fetal heart rate (FHR) often lead to adverse outcomes. The gold standard for improving fetal and neonatal outcomes is continuous FHR monitoring. In cases of fetal distress prediction, monitoring methods such as intermittent auscultation, cardiotocography (CTG), and other assessments are employed, with CTG becoming a routine practice in developed countries.

Objective: To investigate the accuracy of intermittent fetal monitoring in detection of fetal distress in low resource settings.

Methods: This observational cross-sectional study was conducted at tertiary care hospital at Ain Shams University hospitals from October 2023 till July 2024 and performed on total 122 pregnant women aged 18–35 years with a gestational age of 36–40 weeks. Women with major fetal anomalies, cardiac malformations, and absent fetal movements were excluded. This targeted a typical population for low-risk pregnancies, allowing the study to focus on the performance of IFM in uncomplicated cases with inclusion and exclusion criteria.

Results: There was a significant agreement between neonatal distress and IFM distress results where the 2 markers agreed in 87.7% (no distress 78.69% + distress 9.02 %) of cases. Among the group without distress, 48.6% (n=51) of deliveries were normal vaginal deliveries (NVD) and 51.4% (n=54) were cesarean sections (CS). In contrast, all deliveries in the IFM distress group were cesarean sections (100%, n=17). The Chi-square test indicated a significant association between MOD and IFM distress (χ^2=14.19, p<0.001). The mean pH in the no distress group was 7.30±0.06, while in the IFM distress group, it was 7.11±0.13. The t-test showed a statistically significant difference between the groups (t=5.725, p=0.000). Fisher's exact test was used to compare neonatal distress and Apgar scores between groups. In the no distress group, 91.4% (n=96) of neonates had no distress,

Corresponding author:
Nada Ahmed Mohamed Ghozzy,
E-mail: nadaghozzy484@gmail.com
Tel: 01003860392
(1) Assistant Professor of Obstetrics and Gynecology, Faculty of Medicine, Ain Shams University.
(2) Professor of Obstetrics and Gynecology, Faculty of Medicine, Ain Shams University.
(3) Master's degree, Resident of Obstetrics and Gynecology Faculty of Medicine, Ain Shams University.

compared to 35.3% (n=6) in the IFM distress group ($p<0.001$). Similarly, 91.4% (n=96) of neonates in the no distress group had an Apgar score ≥7, while only 35.3% (n=6) of those in the IFM distress group achieved this score ($p<0.001$).

Conclusion: this study demonstrates that intermittent fetal monitoring is a practical and effective solution for managing labor in low-resource settings. It balances reliable detection of fetal distress with the need to minimize unnecessary interventions, making it an essential tool for improving both maternal and neonatal outcomes. However, its moderate sensitivity indicates that IFM should be used alongside other clinical assessments to ensure optimal care for both mothers and their babies.

Keywords: Intermittent Fetal Monitoring, Fetal Distress, emergency caesarean section..

INTRODUCTION

Monitoring of the fetus during pregnancy and labor is important to ensure the delivery of a healthy baby in good condition with the minimum of intervention. Studies found that fetal heart rate (FHR) abnormalities are usually associated with fresh stillbirth, low Apgar scores, and neonatal deaths (1). FHR monitoring is the gold standard for facilitating improved fetal and neonatal outcomes. Proper and adequate monitoring of FHR using sensitive and reliable devices, coupled with timely and appropriate obstetric responses, can dramatically reduce the incidence of intrapartum-related hypoxia, still birth, and neonatal deaths (2).

Fetal monitoring during the preparation of birth aims to predict and diagnose fetal distress to prevent brain damage due to impaired gas exchange. Fetal monitoring includes intermittent auscultation, cardiotocography (CTG), colour and amniotic fluid volume assessment, biophysical profiles assessment, caput in the fetal head (3). CTG is indicated if the fetal heart rate and abnormal uterine contraction are found during impaired intermittent fetal monitoring. Thus, Routine monitoring of FHR using CTG has become an established obstetric practice in developed countries (4).

However, Economic constraints in many parts of the world limit routine and continuous monitoring. Low resource settings (LRSs) are typically regions where inadequate healthcare resources exist and the healthcare system does not meet the acceptable global standards. In busy labor wards with few monitors, selection of the patients for continuous monitoring is necessary thus alternative approaches for monitoring of FHR is required. Intermittent auscultation of the FHR, using either a fetoscope, or the electronic fetal heart rate monitoring (EFM) are the most appropriate alternative method of monitoring in most low-resource settings, where cardiotocography is rarely available (5).

EFM was introduced in the obstetrics practice over 2 decades ago with the expectation that early detection of fetal distress would lead to earlier intervention and improved mortality rates and long-term morbidity. Several studies using suggested that EFM was associated with a decrease in stillbirths by 2-3 per 1000 births and a decrease in neonatal deaths by approximately 6-7 per 1000 births. Such approach may be used for early detection of fetal distress in low resource settings as fetal distress stimulates the concern about the fetal condition and necessitates immediate intervention like caesarean section or instrumental vaginal delivery to prevent fetal death (6). Consequently, this study was conducted and aimed to investigate the accuracy of intermittent fetal monitoring in detection of fetal distress in low resource settings.

PATIENTS AND METHODS

After ethical committee approval and written consents from the patients, this observational cross-sectional study was conducted at tertiary care hospital at Ain Shams University hospitals from October 2023 till July 2024 and performed on total 122 pregnant women aged 18–35 years with a gestational age of 36–40 weeks. Women with major fetal anomalies, cardiac malformations, and absent fetal movements were excluded. This targeted a typical population for low-risk pregnancies, allowing the study to focus on the performance of IFM in uncomplicated cases with inclusion and exclusion criteria.

Inclusion criteria: Age 18-35 years old, Singleton pregnancy, Viable fetus, Cephalic presentation, Gestational age 36-40 Weeks.

Exclusion criteria: Major Fetal anomalies, Known Fetal cardiac malformations or fetal arrhythmias and absent fetal movements.

- **Study Procedures:** Complete history taking including Personal history, Any complaint, Obstetric history, Menstrual history, Past medical and past surgical history and Family history.
- Complete clinical examination:

- Vital signs (Blood pressure, Temperature, Heart rate, Respiratory rate).

- BMI.

- Routine laboratory investigations: CBC, Urine dipstick for proteinuria and Blood glucose level, Renal and hepatic function tests (when indicated).
- Local abdominal examination: Leopold's maneuver.
- Gestational age was confirmed by US.
- FHR was monitored intermittently every 15 minutes with an electronic handheld Doppler device with the patient in a semi-lateral position.
- Referral for emergency cesarean section followed one of the following:

1. Fetal bradycardia (FHR < 100 beats/min) for ≥ 1 minute.
2. Tracing recorded for one of the following after incidental discovery of worrisome fetal heart rate patterns upon intermittent fetal monitoring:

I. Moderate to severe variable decelerations associated with absent beat-to-beat variability.

II. FHR 110 to 160 beats/min associated with persistent absent beat-to-beat variability in the absence of accelerations.

- Beat-to-beat variability was categorized as follow (7):

- Absent, 0 beats/min.

- Minimal, 1 to 5 beats/min.

- Moderate, 6 to 25 beats/min.

- Marked, >25 beats/min.

- Decelerations were defined as follow (8):

- Mild variable decelerations lasts < 30 seconds and maintained FHR > 80 beats/min.

- Moderate variable decelerations reach a nadir of < 80 beats/ min with duration not a factor.

- Severe variable decelerations were associated with heart rates dropping to < 70 beats/min and lasting > 60 second.

- After delivery, the following was performed:

- Arterial blood gas analysis using blood samples obtained from the site of umbilical cord insertion into the placenta. Clamping of the umbilical cord at the fetal site of insertion (Site A), clamping of the umbilical cord at the placental site of insertion (Site B), with a clamp placed in between site A and site B (Site C). Blood sample for ABG was withdrawn between site B and site C. This was done prior to placental separation.

- Apgar score at 5 minutes.

Umbilical cord blood gas sampling whereby pH < 7.2, APGAR score at 5 minutes < 7 was considered cut-off parameters for fetal distress.

- Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of intermittent FHR monitoring were calculated based on CTG findings and postpartum assessment (Blood gases, APGAR scoring and adverse neonatal outcomes).

Sample Size: Assuming a prevalence rate of foetal distress in the research setting of 15% and an expected sensitivity for IFM of 50% and specificity of 60%, a sample of 122 pregnant women subjected to intermittent fetal monitoring, were enough to detect such rates at 0.05 alpha error and 0.80 power of the test (9).

Ethical Considerations: The patient data were anonymous. Data presentation was not by the patient's name but by diagnosis and patient confidentiality was protected. An informed consent was taken from all participants, it was in Arabic language and confirmed by date and time. confidentiality was preserved by assigning a number to patients initials and only the investigator knew it

Conflict of interest: The researcher declared that there is no conflict of interest and the cost of the study was paid by the researcher.

Statistical analysis: Analysis is to be performed using SPSS for windows v20.0, Data to be presented in terms of range, mean and standard deviation (for numeric parametric variables); range, median and inter-quartile range (for numeric non-parametric variables); or number and percentage (for categorical variables). Difference between two independent groups is to be analyzed using independent student's t-test as well as the mean difference and its 95% CI (for numeric parametric variables); or chi-squared test as well as the risk ratio and its 95% CI (for categorical variables). Binary logistic regression analysis is to be performed for estimating the association between good/poor response and the measured variables ROC curves are to be constructed for estimating the validity of measured variables as predictors of good or poor response validity is to be presented in terms of sensitivity, specificity, positive and negative predictive values and their corresponding 95% Cis significance level is set at 0.05.

Results

Table (1): Neonatal distress and complications.

		Mean ± SD	Range
pH		7.27 ± 0.1	6.8 - 7.4
		N	%
Neo distress	no	102	83.6%
	yes	20	16.4%
APGAR <7	no	102	83.6%
	yes	20	16.4%
Maternal Surgical Trauma	no	55	78.6%
	yes	15	21.4%
Neonatal Seizures	no	114	93.4%
	yes	8	6.6%
Need for Oxygen Therapy	no	101	82.8%
	yes	21	17.2%
NICU Admission	no	101	82.8%
	yes	21	17.2%

Neonatal Mortality	no	122	100.0%
	yes	0	0.0%

Table (1) shows that Neonatal distress as defined by various indicators such as low Apgar scores (<7.2), was observed in 16.4% of newborns. The pH of umbilical cord blood at birth had a mean ± SD of 7.27 ± 0.1, with a range of 6.8 to 7.4. The table also reports on the neonatal outcomes, including the need for oxygen therapy (17.2%), NICU admission (17.2%), and neonatal seizures (6.6%). The table further reports maternal surgical trauma associated with delivery, with an incidence of 21.4%.

Table (2): Maternal surgical complications

	N	%
Uterine artery injury	8	53.3%
Bladder injury	3	20.0%
Extension of lower uterine segment incision	4	26.7%
Inferior Epigastric artery avulsion	3	20.0%

Table (2) shows various complications associated with cesarean sections performed in cases of fetal distress. These included uterine artery injury (53.3%), bladder injury (20%), and extension of lower uterine segment incision (26.7%).

Table (3): Agreement between Intermittent Fetal Monitoring and neonatal distress after birth

		Neo distress		Total	Agreement			
		No Distress	Distress		%	Kappa	p value	Sig.
IFM distress	No Distress	96 (78.69%)	9 (7.38%)	105 (86.07%)	87.7%	0.523	<0.001	S
	Distress	6 (4.92%)	11 (9.02%)	17 (13.93%)				
Total		102 (83.61%)	20 (16.39%)	122 (100%)				

Table (3) shows that that there was a significant agreement between Neo distress and IFM distress results where the 2 markers agreed in 87.7% (no distress 78.69% + distress 9.02 %) of cases and kappa = 0.523.

Table (4): Diagnostic Performance of Intermittent Fetal Monitoring

	Ratios
Sensitivity	55.0 %
Specificity	94.1 %
Positive Predictive Value	64.7 %
Negative Predictive Value	91.4 %
Accuracy	87.7 %

Table (4) provides the diagnostic performance of IFM in detecting neonatal distress, with a sensitivity of 55.0%, specificity of 94.1%, PPV of 64.7%, NPV of 91.4%, and an overall accuracy of 87.7%.

Table (5): Mode of Delivery and Intrapartum Fetal Monitoring (IFM) Distress

		No distress		IFM distress		Chi square test		
		N	%	N	%	value	p value	sig.
MOD	NVD	51	48.6%	0	0.0%	14.19	<0.001	S
	CS	54	51.4%	17	100.0%			

Table (5) shows that among the group without distress, 48.6% (n=51) of deliveries were non-vaginal deliveries (NVD) and 51.4% (n=54) were cesarean sections (CS). In contrast, all deliveries in the IFM distress group were cesarean sections (100%, n=17). The Chi-square test indicated a significant association between MOD and IFM distress (χ^2=14.19, p<0.001).

Table (6): Comparison of pH Levels Between Groups with and Without IFM Distress

		No distress		IFM distress		t test		
		Mean	SD	Mean	SD	value	p value	sig.
pH		7.30	0.06	7.11	0.13	5.725	0.000	S
		N	%	N	%	Fisher exact test		
Neo distress	no	96	91.4%	6	35.3%	--	<0.001	S
	yes	9	8.6%	11	64.7%			
APGAR <7	no	96	91.4%	6	35.3%	--	<0.001	S
	yes	9	8.6%	11	64.7%			

Table (6) shows the mean pH in the no distress group was 7.30±0.06, while in the IFM distress group, it was 7.11±0.13. The t-test showed a statistically significant difference between the groups (t=5.725, p=0.000). Fisher's exact test was used to compare neonatal distress and Apgar scores between groups. In the no distress group, 91.4% (n=96) of neonates had no distress, compared to 35.3% (n=6) in the IFM distress group (p<0.001). Similarly, 91.4% (n=96) of neonates in the no distress group had an Apgar score ≥7, while only 35.3% (n=6) of those in the IFM distress group achieved this score (p<0.001).

Table (7): Maternal and Neonatal Outcomes in Relation to IFM Distress

		No distress		IFM distress		Fisher exact test	
		N	%	N	%	p value	sig.
Maternal Surgical Trauma	no	48	90.6%	7	41.2%	<0.001	S
	yes	5	9.4%	10	58.8%		
Neonatal Seizures	no	104	99.0%	10	58.8%	<0.001	S
	yes	1	1.0%	7	41.2%		
Need for Oxygen Therapy	no	96	91.4%	5	29.4%	<0.001	S
	yes	9	8.6%	12	70.6%		
NICU Admission	no	96	91.4%	5	29.4%	<0.001	v
	yes	9	8.6%	12	70.6%		
Neonatal Mortality	no	105	100.0%	17	100.0%	NA	
	yes	0	0.0%	0	0.0%		

Table (7) shows significant associations between IFM distress and several outcomes. The incidence of maternal surgical trauma was higher in the IFM distress group (58.8%, n=10) compared to the no distress group (9.4%, n=5) (p<0.001). Neonatal seizures occurred in 41.2% (n=7) of the IFM distress group, compared to 1.0% (n=1) in the no distress group (p<0.001).

Need for oxygen therapy and NICU admission were also significantly higher in the IFM distress group, with 70.6% (n=12) requiring oxygen and NICU admission, compared to 8.6% (n=9) in the no distress group (p<0.001 for both). Neonatal mortality was not observed in either group

Table (8): Type of fetal distress and Neonatal Outcomes

		Absent beat to beat variability + Moderate/ Severe variable decelerations		Absent beat to beat variability with HR 110-160		Acute fetal bradycardia		ANOVA		
		Mean	SD	Mean	SD	Mean	SD	F	p value	sig.
pH		7.03	0.10	7.21	0.05	7.05	0.16	4.788	0.026	S
		N	%	N	%	N	%	Fisher exact test		
APGAR <7	no	0	0.0%	5	71.4%	1	16.7%	--	0.043	S
	yes	4	100.0%	2	28.6%	5	83.3%			
Neo distress	no	0	0.0%	5	71.4%	1	16.7%	--	0.043	S
	yes	4	100.0%	2	28.6%	5	83.3%			
Maternal Surgical Trauma	no	1	25.0%	4	57.1%	2	33.3%	--	0.564	NS
	yes	3	75.0%	3	42.9%	4	66.7%			
Neonatal Seizures	no	1	25.0%	6	85.7%	3	50.0%	--	0.151	NS
	yes	3	75.0%	1	14.3%	3	50.0%			
Need for Oxygen Therapy	no	0	0.0%	4	57.1%	1	16.7%	--	0.193	NS
	yes	4	100.0%	3	42.9%	5	83.3%			
NICU Admission	no	0	0.0%	4	57.1%	1	16.7%	--	0.193	NS
	yes	4	100.0%	3	42.9%	5	83.3%			

Table (8) shows significant difference between the 3 types of fetal distress regarding pH and Apgar score patients with absent beat to beat variability with HR 110-160 showed higher PH and higher Apgar scores. Other variables showed non-significant association with outcomes.

Table (9): Stage of labor and Neonatal Outcomes

		Not in labor		1st stage		2nd stage		ANOVA		
		Mean	SD	Mean	SD	Mean	SD	F	p value	sig.
pH		7.18	0.09	7.07	0.16	7.12	0.09	4.788	0.026	S
		N	%	N	%	N	%	Fisher exact test		
APGAR <7	no	2	50.0%	3	33.3%	1	25.0%	--	1.000	NS
	yes	2	50.0%	6	66.7%	3	75.0%			
Neo distress	no	2	50.0%	3	33.3%	1	25.0%	--	1.000	NS
	yes	2	50.0%	6	66.7%	3	75.0%			
Maternal Surgical Trauma	no	2	50.0%	5	55.6%	0	0.0%	--	0.203	NS
	yes	2	50.0%	4	44.4%	4	100.0%			
Neonatal Seizures	no	2	50.0%	6	66.7%	2	50.0%	--	1.000	NS
	yes	2	50.0%	3	33.3%	2	50.0%			

Need for Oxygen Therapy	no	2	50.0%	3	33.3%	0	0.0%	--	0.504	NS
	yes	2	50.0%	6	66.7%	4	100.0%			
NICU Admission	no	2	50.0%	3	33.3%	0	0.0%	--	0.504	NS
	yes	2	50.0%	6	66.7%	4	100.0%			

Table (9) shows significant difference between the stages of labor regarding pH patients who were in the first stage showed lower PH. Other variables showed non-significant association with outcomes.

DISCUSSION

Intermittent auscultation and continuous cardiotocography (CTG) are the main methods of monitoring the fetal heart rate and provide an indirect assessment of fetal well-being during labor. Intermittent auscultation involves auscultation of the fetal heart rate at determined intervals employing either a Doppler ultrasound device or a Pinard stethoscope and the continuous CTG involves the continuous electronic fetal heart rate monitoring for the evaluation of fetal well-being in labor (10).

Since fetal monitoring in low-resource settings represents major conflict and may associated with fetal complications, evaluating the effectiveness of different tools for Intermittent auscultation (IA) of the fetal heart rate during labor including frequency and duration of auscultation was highlighted as a main point of interest (11).

Accordingly, this study was conducted and aimed to investigate the accuracy of intermittent fetal monitoring in detection of fetal distress in low resource settings.

This observational cross-sectional study was conducted at tertiary care hospital at Ain Shams University hospitals from October 2023 till July 2024 and performed on total 122 pregnant women aged 18–35 years with a gestational age of 36–40 weeks. Women with major fetal anomalies, cardiac malformations, and absent fetal movements were excluded. This targeted a typical population for low-risk pregnancies, allowing the study to focus on the performance of IFM in uncomplicated cases

As regards maternal and neonatal characteristics, the average maternal age was 28.5 years, and the mean body mass index (BMI) was 29.46 kg/m², indicating that the women were in the typical reproductive age range and slightly overweight. A majority of the participants (62.3%) were multiparous, and a significant proportion (58.2%) underwent cesarean sections (CS), with 23.9% of these CS performed due to fetal distress identified through IFM. This relatively high rate of cesarean sections reflects global trends in obstetric care, particularly in low-resource settings where the risks associated with vaginal delivery are often mitigated through more conservative interventions such as CS.

The current study further assessed the diagnostic performance of IFM, reporting an overall accuracy of 87.7%, with a sensitivity of 55.0% and a specificity of 94.1%. These results indicate that while IFM is very good at correctly identifying cases without fetal distress (specificity), it is less reliable in detecting all cases of true distress (sensitivity). The positive predictive value (PPV) of 64.7% and the negative predictive value (NPV) of 91.4% emphasize that IFM performs better at confirming healthy pregnancies than accurately detecting distressed fetuses.

To the best of our knowledge, there is a paucity of studies in literature evaluating the Intermittent auscultation of the fetal heart rate during labor in low-resource countries, and that represents a strength point of our study

Anitha, & Jagathyayini. (12) conducted a prospective study that enrolled 1,000 women in labor and monitored fetal distress using intermittent auscultation (IA) and reported a high sensitivity of 93.7% for intermittent auscultation in detecting fetal distress, whereas our study found a lower sensitivity of 55% for IFM. Both studies, however, showed high specificity, indicating that IFM and IA are reliable at ruling out fetal distress when not present.

Martis et al. (13) and Vintzileos et al. (14) did not specifically report PPV or NPV for IFM. However, both studies emphasized that electronic fetal monitoring (EFM) detects more cases of fetal distress but is associated with higher cesarean section rates without clear evidence of improved neonatal outcomes like Apgar scores or NICU admissions. This suggests that while advanced monitoring techniques like EFM have high sensitivity, they may also have lower PPV, leading to more false positives and unnecessary surgeries.

As regards Neonatal outcomes, our study results showed significant associations with fetal distress detected by IFM. Distressed newborns had markedly lower pH levels (mean pH 7.11 compared to 7.30 in non-distressed neonates), and only 35.3% of distressed babies had an Apgar score above 7, compared to 91.4% of those without distress. In addition, neonatal seizures were significantly more common in the distress group, affecting 41.2% of distressed neonates compared to just 1.0% in non-distressed cases. The need for oxygen therapy and NICU admissions were also significantly higher in the distressed group, further underscoring the importance of effective fetal monitoring for predicting adverse neonatal outcomes.

Kumari et al. (10) conducted a prospective randomized study that enrolled 200 low risk pregnant women and found no significant differences between the two groups in terms of Apgar scores or neonatal intensive care unit (NICU) admissions. Apgar scores of less than 7 at 1 minute showed no significant differences, with a p-value of 0.07. Similarly, the rates of NICU admissions were statistically comparable, with no significant difference between the CTG and IA groups (p-value = 0.7). These findings suggest that continuous CTG monitoring did not provide any added benefit in neonatal outcomes for low-risk pregnancies when compared to intermittent Auscultation (IA).

Ultimately, **Kumari et al. (10)** reported that the sensitivity of CTG in predicting fetal compromise was reported at 63.63%, with a specificity of 80.35%, a positive predictive value of 33.3%, and a negative predictive value of 94.93%. These values demonstrate that CTG has a relatively high rate of false positives, which contributes to unnecessary interventions without significantly improving perinatal outcomes. The study concludes that intermittent auscultation is as effective as continuous CTG in enhancing perinatal outcomes for low-risk pregnancies.

In comparison, the study by **Anitha, & Jagathyayini. (12)** found that 7.5% of neonates were diagnosed with fetal distress, and **21.3%** of these cases had Apgar scores below 7. However, among those without fetal distress, only **0.6%** had low Apgar scores, demonstrating the effectiveness of IA in detecting fetal distress and preventing adverse outcomes.

In addition, the systematic review by **Gourounti & Sandall., (15)** compared IA and CTG and found no significant difference in neonatal Apgar scores at 5 minutes, with both methods yielding comparable outcomes in terms of fetal well-being. The relative risk (RR) for having an Apgar score below 7 was 1.35 for CTG, indicating no significant advantage over IA. Similarly, **Wood., (16)** reported that IA led to higher Apgar scores and fewer neonatal complications like seizures and NICU admissions compared to continuous CTG. Overall, these studies support the conclusion that IA is as effective as CTG in ensuring positive fetal outcomes, particularly in low-risk pregnancies, while reducing unnecessary interventions.

As regards type of Fetal Distress, the study categorized fetal distress into different types to analyze their impact on neonatal outcomes, including absent beat-to-beat variability with moderate/severe variable decelerations, absent beat-to-beat variability with a heart rate of 110–160 beats per minute, and acute fetal bradycardia. These types of fetal distress were associated with significantly different neonatal outcomes.

Neonates experiencing absent beat-to-beat variability with moderate/severe decelerations had the lowest mean pH of 7.03 (indicating more severe distress), while those with absent beat-to-beat variability but normal heart rate had a higher mean pH of 7.21, suggesting less severe distress (p = 0.026). This relationship between the type of distress and pH levels highlights the varying severity of oxygen deprivation based on the type of fetal distress.

In addition, Neonates with absent beat-to-beat variability with moderate/severe decelerations had the poorest Apgar scores, with 100% scoring below 7, indicating severe distress. In contrast, 71.4% of those with absent beat-to-beat variability but normal heart rate had Apgar scores above 7, reflecting better neonatal outcomes (p = 0.043).

The incidence of neonatal distress followed a similar pattern, with all neonates (100%) experiencing absent beat-to-beat variability with decelerations suffering distress, whereas only 28.6% of those with absent beat-to-beat variability but normal heart rate experienced distress. This underscores the fact that not all forms of fetal distress result in equally poor neonatal outcomes.

These findings indicate that certain types of fetal distress, particularly those involving both beat-to-beat variability and decelerations, are more likely to result in adverse neonatal outcomes, including low pH, poor Apgar scores, and higher rates of neonatal distress.

As regards stage of Labor and Neonatal Outcomes, the stage of labor during which fetal distress occurs also plays a significant role in determining neonatal outcomes. The study analyzed distress occurring in the first stage, second stage, and before labor, with findings indicating that earlier stages of labor are associated with more severe outcomes. Neonates whose distress occurred during the first stage of labor had the lowest mean pH of 7.07, suggesting more severe acidosis. In contrast, those not yet in labor had a higher mean pH of 7.18 (p = 0.026). This highlights that fetal distress in early labor might lead to more prolonged exposure to suboptimal conditions, contributing to worse outcomes.

Apgar scores and the presence of neonatal distress were notably worse in cases of fetal distress during the second stage of labor. Of the neonates distressed during this stage, 75% had Apgar scores below 7, and an equal percentage experienced neonatal distress. Although distress in the first stage also resulted in adverse outcomes, the second stage, when delivery is imminent, seems to pose a higher risk for poor neonatal health. While other variables, such as maternal surgical trauma and neonatal complications (e.g., seizures or the need for oxygen therapy), did not show significant differences based on the stage of labor, the trend indicates that complications are more likely when fetal distress occurs later, particularly during the second stage.

Maternal outcomes are crucial when assessing the impact of different fetal monitoring techniques on the overall safety and well-being of mothers during labor. Our study results revealed that women in the distressed group experienced a higher rate of maternal surgical trauma (58.8%) compared to only 9.4% in the non-distressed group. This may be attributable to the urgent or aggressive interventions needed to address fetal distress, which often increases the risk of complications during cesarean delivery.

Additionally, all distressed cases (100%) were delivered via cesarean section, with none delivered vaginally, pointing to the crucial role of cesarean sections in managing fetal distress when detected by IFM. However, our study documented various complications associated with cesarean sections performed in cases of fetal distress. These included uterine artery injury (53.3%), bladder injury (20%), and extension of lower uterine segment incision (26.7%). Such complications underscore the increased risk for mothers who undergo cesarean sections, particularly in cases where fetal distress is identified through intermittent fetal monitoring. The need for rapid intervention in cases of fetal distress may increase the likelihood of surgical errors or complications during cesarean procedures.

Anitha, & Jagathyayini., (12) did not report a significant increase in cesarean sections due to the use of IA, demonstrating that IA can effectively reduce the need for surgical interventions without compromising fetal outcomes.

In the meta-analysis by **Gourounti & Sandall., (15)**, CTG was associated with a higher rate of cesarean sections and instrumental deliveries compared to IA. The RR for cesarean sections was 1.2, and for instrumental deliveries, it was 1.1, showing that continuous CTG monitoring led to more interventions without improving neonatal outcomes. Wood (16) also reported that IA was associated with fewer cesarean sections and a lower rate of instrumental deliveries compared to CTG. This study emphasized the role of IA in promoting a more natural birth process, reducing the likelihood of unnecessary interventions, and enhancing maternal outcomes.

Kumari et al. (10) found a significantly higher incidence of cesarean deliveries (LSCS) in the CTG group compared to the IA group. Specifically, 23% of women in the CTG group underwent emergency cesarean sections, whereas only 9% of those in the IA group required this intervention. The increase in cesarean deliveries in the CTG group was largely due to presumed fetal compromise identified by continuous monitoring, resulting in a relative risk (RR) of 2.5 for cesarean delivery. This finding suggests that false-positive results in CTG monitoring often led to unnecessary surgical interventions.

Moreover, Martis et al. (13) and Vintzileos et al. (14), both highlighted the higher incidence of cesarean sections associated with EFM. In the Martis et al. review, women undergoing EFM were more likely to have cesarean sections for fetal distress (RR 2.92) compared to those undergoing intermittent auscultation, suggesting that more advanced monitoring methods may lead to more interventions without necessarily improving neonatal outcomes. However, the study did not find substantial differences in maternal surgical trauma between the groups.

Ajah et al. (9) found that 8.9% of all cesarean sections performed in their study were due to fetal distress. However, out of all the cesareans performed for fetal distress, 70.9% were deemed unnecessary based on the absence of true fetal distress, leading to unnecessary surgical interventions in the remaining cases. Although the study didn’t specifically report on surgical trauma, the high rate of cesarean sections based on misdiagnosed fetal distress implies a risk of unnecessary maternal complications due to surgery.

Martis et al., (13) and Ajah et al., (9) did not provide specific data on cesarean-related complications but highlighted the dangers of performing unnecessary cesareans based on false diagnoses of fetal distress. The high rate of unnecessary surgeries suggests that many women might have been exposed to avoidable surgical risks, which could include complications like infection, hemorrhage, or prolonged recovery times.

Ultimately, the current study has several important clinical implications, particularly for managing labor and delivery in environments with limited resources. One of the key findings is that intermittent fetal monitoring (IFM) can serve as a viable option in these settings for detecting fetal distress. The study showed that IFM has an overall accuracy of 87.7%, with a high specificity of 94.1%

and a negative predictive value (NPV) of 91.4%. This means IFM is effective at ruling out fetal distress in most cases, allowing healthcare providers to focus on those most likely to need intervention. Given the limited availability of continuous monitoring methods like electronic fetal monitoring (EFM) in low-resource environments, IFM provides a cost-effective alternative that requires minimal equipment and trained staff, while still delivering reliable results.

The study underscores the need for adequate training of healthcare providers in the use of intermittent fetal monitoring. Given its reliance on periodic assessments rather than continuous data, resident physicians and clinicians must be skilled in interpreting fetal heart rate patterns and responding appropriately to subtle signs of distress. This highlights the importance of investing in healthcare worker training programs in low-resource settings to ensure that IFM is used effectively and consistently.

Additionally, resource allocation should focus on equipping maternity units with affordable, reliable Doppler devices or Pinard stethoscopes and ensuring that healthcare teams are adequately staffed to perform regular intermittent monitoring during labor.

The strength points of this study:

One of the key strengths of this study is its applicability to low-resource settings. By focusing on the effectiveness of intermittent fetal monitoring (IFM) in environments where continuous monitoring methods, such as electronic fetal monitoring (EFM), may not be feasible, the study addresses a significant gap in clinical care. The findings demonstrate that IFM can be used effectively with minimal equipment and specialized training, making it a valuable tool for healthcare providers working in areas with limited resources.

Another strength lies in the real-world application of the study. Conducted in a busy maternity unit, the study reflects the practical challenges and successes of using IFM in actual clinical settings, making the results highly relevant to similar healthcare environments. Moreover, the study's clear demonstration of a strong correlation between IFM-detected distress and neonatal outcomes—such as low Apgar scores and lower pH levels—validates IFM as an effective diagnostic tool in predicting adverse neonatal conditions, thereby allowing for timely medical interventions. The study's design, focusing on a well-defined population with clear inclusion and exclusion criteria, adds robustness to the findings by ensuring that the outcomes specifically reflect the performance of IFM in relatively low-risk pregnancies.

The limitations of the study:

Despite its strengths, the study has some notable limitations. The most significant limitation is the moderate sensitivity (55%) of IFM, which indicates that it may miss a substantial number of true fetal distress cases. This could lead to delayed intervention in some high-risk situations, potentially resulting in worse neonatal outcomes for those undetected cases. The study highlights the need for complementary monitoring techniques or increased clinical vigilance to address this gap, but it doesn't offer specific strategies on how this could be practically implemented in low-resource settings.

Another limitation is the study's sample size and single-center design, which may restrict the generalizability of the findings. Conducted in a specific hospital setting, the results may not fully apply to other healthcare environments with different patient populations, varying levels of healthcare worker expertise, or differing access to medical equipment. Additionally, while the study successfully highlights the diagnostic accuracy of IFM, it does not provide long-term follow-up data on neonatal outcomes beyond birth. Information on developmental milestones, incidence of cerebral palsy, or other long-term complications would have provided a more comprehensive understanding of the effectiveness of IFM in preventing adverse outcomes over time.

CONCLUSION

In conclusion, this study demonstrates that intermittent fetal monitoring is a practical and effective solution for managing labor in low-resource settings. It balances reliable detection of fetal distress with the need to minimize unnecessary interventions, making it an essential tool for improving both maternal and neonatal outcomes. However, its moderate sensitivity indicates that IFM should be used alongside other clinical assessments to ensure optimal care for both mothers and their babies.

Additional Information

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosures

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