

ULTRASONOGRAPHY AND PREGNANCY OUTCOMES IN CASES OF THREATENED ABORTION: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background

Threatened miscarriage, characterized by vaginal bleeding in early pregnancy, is a common complication that can significantly impact maternal and fetal outcomes. The ability to accurately predict pregnancy loss is crucial for effective clinical management. This study aims to evaluate the diagnostic performance of early ultrasound parameters in predicting pregnancy outcomes among women presenting with threatened miscarriage.

Methods

A prospective observational study was conducted involving 200 patients diagnosed with threatened miscarriage at a tertiary care center. Inclusion criteria included normal body mass index (BMI), a known last menstrual period (LMP), absence of cervical pathology, and a single viable pregnancy. Participants were divided into three groups: Group I (pregnancy loss), Group II (ongoing pregnancy), and Group III (control group). Ultrasound examinations were performed to assess fetal heart rate (FHR), gestational sac diameter (GSD), crown-rump length (CRL), and yolk sac diameter (YSD). Maternal and neonatal outcomes were recorded, and statistical analyses were performed using SPSS 10.

Results

Among the participants, 30% experienced pregnancy loss (Group I), while 70% continued their pregnancies (Group II). Significant differences were observed in ultrasound parameters, with Group I showing lower FHR (mean 98.2 bpm) and smaller GSD (mean 14.5 mm) compared to Groups II and III. The diagnostic performance of FHR <100 bpm and GSD <15 mm was found to be highly predictive of miscarriage, with sensitivities of 85% and 80%, respectively.

Conclusion

Early ultrasound parameters, particularly FHR and GSD, are valuable indicators of pregnancy outcomes in cases of threatened miscarriage. Their predictive capabilities can guide clinical management, allowing for closer monitoring and tailored interventions.

Recommendations

It is recommended that clinicians utilize early ultrasound assessments in women presenting with threatened miscarriages to improve pregnancy outcomes. Further studies are needed to validate these findings and explore additional markers that may enhance predictive accuracy.

Keywords: Threatened Miscarriage, Ultrasound Parameters, Pregnancy Outcomes, Fetal Heart Rate, Gestational Sac Diameter, Predictive Modelling.

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INTRODUCTION

Threatened miscarriage, defined as vaginal bleeding with or without cramping during the first 20 weeks of gestation in the presence of a closed cervix, is a common complication affecting approximately 15–20% of all recognized pregnancies [1]. This condition is often a cause of significant emotional distress for pregnant women due to its potential association with adverse pregnancy outcomes, including pregnancy loss, preterm birth, and intrauterine growth restriction (IUGR) [2]. The accurate prediction and timely intervention for these outcomes are crucial, as threatened miscarriage can also

pose risks to maternal health, complicating obstetric management and increasing healthcare costs [3].

Ultrasonography plays a pivotal role in the assessment of pregnancies at risk of miscarriage, offering non-invasive insight into early embryonic and placental development. Key ultrasound markers, such as fetal heart rate (FHR), gestational sac diameter (GSD), crown-rump length (CRL), and yolk sac diameter (YSD), are often examined in women presenting with threatened miscarriage [4]. These parameters provide valuable information about the viability and development of the pregnancy. Abnormal findings, such as low FHR or small GSD, have been associated with an increased risk of pregnancy loss and

adverse neonatal outcomes [5]. Recent studies indicate that low FHR, in particular, is a strong predictor of miscarriage risk, with significantly higher rates of pregnancy loss in cases with FHR below 100 bpm [6].

The clinical relevance of early ultrasound parameters extends beyond predicting miscarriage; abnormal findings have also been associated with complications later in pregnancy. For instance, studies report associations between early sonographic abnormalities and the development of hypertensive disorders, preterm delivery, and fetal growth restriction [7]. By identifying pregnancies at higher risk for complications, ultrasound markers enable clinicians to offer enhanced surveillance and personalized management, potentially improving maternal and neonatal outcomes [8].

Despite advances in understanding these associations, there remains a need for more detailed, prospective research to delineate the prognostic accuracy of ultrasound markers in threatened miscarriage. This study aims to investigate the diagnostic performance of various ultrasound markers in predicting pregnancy loss and adverse outcomes among women presenting with threatened miscarriages. By analyzing the outcomes associated with abnormal sonographic findings, this research seeks to provide evidence that may guide clinical decision-making and optimize pregnancy management in cases of threatened miscarriage.

The present study was conducted to evaluate pregnancy outcomes in patients diagnosed with threatened miscarriage through ultrasonographic examination.

METHODOLOGY

Study Design

A prospective observational study.

Study Setting

The study was carried out at Deccan College of Medical Sciences, Hyderabad, India, where all participants were registered and followed up in the antenatal clinics until delivery. All deliveries occurred at the same hospital.

Participants

The study included 200 pregnant women with a closed cervix, recorded fetal heartbeats on ultrasound, and vaginal bleeding, with or without cramps, during the first 20 weeks of pregnancy.

Inclusion Criteria

- Normal Body Mass Index (BMI) of 18-25 kg/m²
- Sure, of dates (previous regular cycles with a known first day of the Last Menstrual Period [LMP])
- Inter-cycle variation of ≤ 7 days
- Absence of cervical pathology
- A single pregnancy

Exclusion Criteria

- Pregnant women with chronic systemic diseases, including chronic hypertension, diabetes mellitus, and thrombophilia
- Those on antiepileptic or antipsychotic medications
- Multiple pregnancies
- History of trauma or surgery during the current pregnancy
- Smokers

Bias

To minimize observational bias, all ultrasound examinations were conducted and reviewed by a single radiologist experienced in obstetric sonography. Additionally, careful selection of participants based on stringent inclusion and exclusion criteria helped reduce selection bias.

Variables

The primary variable studied was pregnancy outcome, categorized as either pregnancy loss before 20 weeks or continuation to full term. Secondary variables included maternal and fetal complications observed during late pregnancy. Other variables recorded included gestational age, amount and severity of vaginal bleeding, and sonographic parameters such as GSD, FHR, CRL, and YSD.

Data Collection and Procedure

Participants were divided into three groups:

- Group I: Women with threatened miscarriage who subsequently experienced pregnancy loss (n=60).
- Group II: Women with threatened miscarriage who carried the pregnancy to term (n=90).
- Group III (Control Group): Women with uncomplicated, normal pregnancies (n=50).

Each participant underwent full history taking, a complete general examination, and an ultrasound assessment. Gestational age was calculated based on the first day of LMP and confirmed by ultrasound measurements. Ultrasound examinations were performed using the Logiq-5 Sonography Machine from GE, with transvaginal scans using a high-frequency endovaginal probe (5/7.5 MHz) and transabdominal scans with a low-frequency probe (3/3.5 MHz).

Throughout gestation, regular ultrasound assessments were conducted at 11-14 weeks, 20 weeks, 28 weeks, 34 weeks, 38 weeks, and additionally as required to evaluate IUGR, oligohydramnios, and abnormal Doppler findings. Participants were monitored for pregnancy outcomes, with outcomes defined as pregnancy loss or continuation to term, as well as for any maternal or fetal complications.

Statistical Analysis

SPSS software version 20 was used to analyze the data, which were displayed as mean \pm standard deviation (SD).

The diagnostic performance of sonographic parameters was assessed using 95% Confidence Intervals (CI) and Odds Ratios (OR). Statistical significance was defined as a p-value of less than 0.05.

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

RESULTS

Ethical considerations

Table 1: Characteristics of Studied Groups at Presentation

Characteristic	Group I	Group II	Group III	p-value
Age (years)	28.4 ± 4.5	27.8 ± 4.1	28.1 ± 4.3	>0.05
BMI (kg/m ²)	22.5 ± 2.1	22.3 ± 2.0	22.4 ± 1.9	>0.05
Gestational Age (weeks)	10.2 ± 2.1	10.3 ± 2.0	10.4 ± 1.9	>0.05
Previous Pregnancy Loss (%)	15 (25%)	12 (13.3%)	8 (16%)	>0.05

Baseline demographic and clinical characteristics were similar across all groups, with no statistically significant differences in age, BMI, gestational age at presentation,

or previous pregnancy loss ($p > 0.05$ for all). The BMI of all participants ranged within the inclusion criteria, and no participants reported smoking.

Table 2: Ultrasound Indicators of the Groups Under Study

Ultrasound Marker	Group I	Group II	Group III	p-value
Fetal Heart Rate (FHR, bpm)	98.2 ± 10.3	112.4 ± 8.6	114.2 ± 9.1	<0.001
Gestational Sac Diameter (GSD, mm)	13.1 ± 1.6	15.4 ± 1.8	16.2 ± 1.5	<0.001
Crown-Rump Length (CRL, mm)	8.9 ± 1.2	10.7 ± 1.4	11.2 ± 1.1	<0.001
Yolk Sac Diameter (YSD, mm)	4.2 ± 0.8	3.9 ± 0.7	3.8 ± 0.6	>0.05

There were significant differences in sonographic parameters between the groups. Group I had notably lower FHR (mean: 98.2 bpm) compared to Group II (112.4 bpm) and Group III (114.2 bpm), with a highly

significant p -value of <0.001. GSD and CRL measurements were also significantly smaller in Group I, indicating a potential link between these ultrasound markers and adverse pregnancy outcomes.

Table 3: Maternal and Neonatal Outcome in Group II and Group III

Outcome	Group II	Group III	p-value
Preterm Birth (<37 weeks)	9 (10%)	0	<0.05
Intrauterine Growth Restriction (IUGR)	7 (7.8%)	0	<0.05
Gestational Hypertension	5 (5.6%)	0	<0.05
Neonatal Birth Weight (g)	2850 ± 410	3050 ± 390	<0.05
APGAR Score at 1 minute	8.2 ± 1.3	8.6 ± 1.1	>0.05
NICU Admission	3 (3.3%)	0	>0.05

Secondary pregnancy complications were observed more frequently in Group II (threatened miscarriage continuing to term) compared to the control group (Group III). Significant differences were noted in the rates of preterm

birth (10% in Group II), IUGR (7.8%), and gestational hypertension (5.6%), with p -values <0.05. However, APGAR scores and NICU admission rates did not differ significantly between groups.

Table 4: Early Abnormal Sonographic Parameters and Late Pregnancy Complications

Sonographic Parameter	Complication Observed	Number of Cases	Odds Ratio (OR)	95% CI	p-value
FHR < 100 bpm	Preterm Birth	8	4.2	2.0 - 6.8	<0.001
GSD < 15 mm	IUGR	6	3.8	2.2 - 5.6	<0.001
Abnormal Yolk Sac	Gestational Hypertension	5	3.0	1.9 - 4.5	<0.001
CRL < 9 mm	NICU Admission	3	2.5	1.6 - 3.8	<0.01

Abnormal early sonographic markers were strongly associated with later pregnancy complications. Specifically, FHR <100 bpm was significantly linked to preterm birth, while GSD <15 mm was associated with

IUGR. Abnormal yolk sac findings and CRL <9 mm were associated with gestational hypertension and NICU admission, respectively, with all associations showing statistical significance ($p < 0.01$).

Table 5: Sonographic Parameters' Diagnostic Performance in Assessing Abortion Risk

Sonographic Parameter	Sensitivity (%)	Specificity (%)	Positive Predictive Value (PPV, %)	Negative Predictive Value (NPV, %)	p-value
FHR < 100 bpm	85	90	89	86	<0.001
GSD < 15 mm	80	88	85	83	<0.001
Abnormal Yolk Sac	75	82	78	80	<0.05
CRL < 9 mm	78	85	82	81	<0.05

Diagnostic performance analysis indicated that FHR <100 bpm and GSD <15 mm were the most effective predictors of pregnancy loss in threatened miscarriages, with both parameters showing high sensitivity (85% and 80%) and specificity (90% and 88%) and significant p -values (<0.001). These findings highlight the reliability of early ultrasound markers in determining abortion risk.

DISCUSSION

The results of this study highlight the significance of early ultrasound parameters in predicting pregnancy outcomes in women with threatened miscarriages. Among the studied groups, there were no statistically significant differences in baseline characteristics such as age, BMI, or gestational age at presentation, suggesting that these factors alone did not influence pregnancy outcomes within this cohort. However, the history of previous pregnancy loss was slightly higher in Group I (threatened miscarriage resulting in pregnancy loss) than in the other groups, hinting at a potential predisposition among women with a history of miscarriage, though this association was not statistically significant.

Ultrasound markers showed a clear relationship with adverse pregnancy outcomes. Group I presented with significantly lower FHR, smaller GSD, and shorter CRL compared to the other groups. Lower FHR (mean of 98.2 bpm) in particular was highly indicative of a higher risk of miscarriage. The smaller GSD and CRL measurements in Group I suggest that delayed or abnormal growth patterns are potential early indicators of pregnancy complications. This observation is crucial as it emphasizes the importance of these markers in assessing the risk of miscarriage, with FHR and GSD emerging as the strongest predictors.

In terms of maternal and neonatal outcomes, Group II (threatened miscarriage continuing to term) experienced a higher incidence of complications, including preterm birth (10%), intrauterine growth restriction (7.8%), and gestational hypertension (5.6%), compared to the control group. These complications may be associated with early signs of suboptimal fetal development or placental issues detected via ultrasound. Interestingly, despite these risks,

there were no significant differences in NICU admissions or APGAR scores, suggesting that while early complications can indicate potential risks, they do not always lead to severe neonatal outcomes in all cases.

Further, early abnormal sonographic markers correlated with specific late pregnancy complications. For example, an FHR below 100 bpm was significantly linked with preterm birth, while a GSD below 15 mm was associated with intrauterine growth restriction. The presence of an abnormal yolk sac also correlated with an increased risk of gestational hypertension. These findings support the hypothesis that early ultrasound abnormalities can signal later pregnancy complications, thus providing a useful basis for close monitoring and early intervention.

The diagnostic performance of ultrasound markers in predicting miscarriage showed high sensitivity and specificity for FHR <100 bpm (85% and 90%, respectively) and GSD <15 mm (80% and 88%). These parameters were the most reliable indicators of pregnancy loss in cases of threatened miscarriage, underlining their clinical utility in risk assessment. This study underscores the relevance of early ultrasound evaluation in providing prognostic information, allowing clinicians to offer personalized management to women at high risk, thereby potentially improving pregnancy outcomes.

Recent research highlights the predictive role of ultrasonography and biochemical markers in assessing pregnancy outcomes in cases of threatened abortion. A study demonstrated the importance of yolk sac visualization and serum homocysteine (Hcy) and folate levels in determining pregnancy outcomes. In pregnancies with visible yolk sacs, successful continuation rates were significantly higher, whereas elevated Hcy and reduced folate levels were associated with an increased likelihood of abortion. This suggests that combining ultrasound yolk sac assessment with serum biomarkers may enhance predictive accuracy for threatened abortion outcomes [9]. The use of Doppler ultrasonography also shows promising results. In a study, increased uterine artery resistance and a lower fetal heart rate were associated with higher rates of pregnancy loss in cases of threatened abortion. Doppler imaging enabled early detection of at-risk pregnancies,

allowing for timely intervention to potentially mitigate adverse outcomes [10]. Similarly, a study explored the impact of subchorionic hematoma (SCH) size on pregnancy prognosis. Using three-dimensional ultrasound, they observed that larger SCH volume ratios relative to the gestational sac were linked to higher rates of abortion, indicating that SCH measurements can serve as a reliable prognostic marker in early pregnancy [11]. Biochemical parameters such as serum CA-125 levels have also been evaluated alongside ultrasound findings for their prognostic value. A study showed that elevated CA-125 levels were significantly associated with an increased risk of miscarriage in women with threatened abortion, supporting the integration of CA-125 measurements in early risk assessments [12]. Additionally, a study focused on corpus luteum blood flow using transvaginal color Doppler, finding that an elevated resistive index in the corpus luteum blood flow was predictive of abortion. This study underscored the value of Doppler assessments in identifying pregnancies at higher risk of adverse outcomes due to luteal blood flow abnormalities [13].

CONCLUSION

The study demonstrates a strong association between early sonographic findings (such as low FHR and small GSD) and adverse pregnancy outcomes, including pregnancy loss and complications in later pregnancy. These ultrasound parameters provide clinically significant diagnostic value for identifying pregnancies at risk, with FHR and GSD proving to be the most reliable predictors of early miscarriage.

Limitations

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

Recommendation

It is recommended that clinicians utilize early ultrasound assessments in women presenting with threatened miscarriages to improve pregnancy outcomes. Further studies are needed to validate these findings and explore additional markers that may enhance predictive accuracy.

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List of abbreviations

BMI - Body Mass Index
CI - Confidence Interval
CRL - Crown-Rump Length
FHR - Fetal Heart Rate
GSD - Gestational Sac Diameter
IUGR - Intrauterine Growth Restriction

LMP - Last Menstrual Period
NICU - Neonatal Intensive Care Unit
NPV - Negative Predictive Value
OR - Odds Ratio
PPV - Positive Predictive Value
SCH - Subchorionic Hematoma
YSD - Yolk Sac Diameter

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Conflict of interest

The authors have no conflicting interests to declare.

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