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Original Research Article

Role of Ultrasonography in Improving Diagnostic Accuracy and Guiding Management of First-Trimester Bleeding

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Abstract:

Background: First trimester bleeding is a common obstetric problem with diverse etiologies ranging from benign to life-threatening conditions. Clinical assessment alone often lacks accuracy due to overlapping presentations.

Aim: To evaluate the role of ultrasonography in improving diagnostic accuracy and guiding management in women presenting with first trimester bleeding.

Methodology: A prospective observational study was conducted over six months on 82 pregnant women with first trimester bleeding at RDJM Medical College and Hospital,Turki, Muzaffarpur, Bihar, India. All participants underwent detailed clinical evaluation followed by transabdominal and/or transvaginal ultrasonography. Clinical diagnoses were compared with ultrasonographic findings, and their impact on management decisions was analyzed.

Results: Ultrasonography identified threatened abortion as the most common diagnosis (43.9%). Concordance between clinical and USG diagnosis varied across conditions, with significant misclassification noted clinically, especially in complete abortion, missed abortion, and ectopic pregnancy. Clinical diagnosis showed high accuracy for viable intrauterine pregnancy (83%) and ectopic pregnancy (98%) but lower accuracy for non-viable intrauterine pregnancy (63%). Ultrasonography significantly improved diagnostic precision and influenced appropriate management.

Conclusion: Ultrasonography is an indispensable tool in the evaluation of first trimester bleeding, significantly enhancing diagnostic accuracy and guiding timely, appropriate management while reducing unnecessary interventions and complications.

Keywords: First Trimester Bleeding, Ultrasonography, Diagnostic Accuracy, Early Pregnancy, Ectopic Pregnancy, Abortion.

Introduction

The first trimester bleeding, which can be described as any vaginal bleeding during the first 12 weeks of gestation, is a very frequent and clinical issue that arises in obstetric practice. Ideally, any bleeding in early pregnancy is taken to be a threat to abortion unless a non-threatening cause is determined conclusively [1]. This first trimester bleeding phenomenon tends to raise significant anxiety in the patient and a difficult diagnosis to the clinician because the causes of these conditions can be benign conditions to life-threatening obstetric crises. Epidemiological evidence shows that first trimester bleeding is almost a quarter of all pregnancies and thus it is one of the most common complications of early pregnancy. Out of these incidences, it has been shown that close to half thus end up in miscarriage and the other half end up terminating bleeding and continuing with a normal pregnancy. This broad range of consequences indicates the relevance of timely and precise diagnosis and proper treatment to maximize maternal and fetal outcomes [2].

The etiology of first trimester bleeding may be generalized as obstetric and non-obstetric. Non-obstetric etiologies are the trauma to the genital tract, cervicitis, vaginitis, cystitis, cervical polyps, cervical carcinoma. Obstetric causes are more closely related to pregnancy, and they are embryonic demise, subchorionic hemorrhage, anembryonic pregnancy, unsuccessful abortion, ectopic pregnancy and gestational trophoblastic diseases [3]. Both these conditions vary greatly in terms of prognosis and

management and therefore accurate diagnosis is very important. Nevertheless, clinical history and physical examination are not always enough in making a conclusive and precise diagnosis in an instance of first trimester bleeding. Symptoms that overlap like pain, bleeding pattern and uterine size often impair the clinician to differentiate between viable and non-viable pregnancies or detect any conditions that may be at risk like ectopic pregnancy at early stages [4].

Ultrasonography in this regard has turned out to be an essential diagnostic tool in the assessment of early pregnancy. The use of ultrasound in obstetric examination, especially in the first trimester, is critically important because of its safety and accessibility, as well as diagnostic quality. It is known to produce no known biological side effects on the fetus when used at normal diagnostic frequencies of 2.5 to 15 MHz even after over half of the last fifty years of widespread use in obstetrics [5]. The ultrasound system is non-invasive and has the ability to give real time images, which aid clinicians to see early gestational structures, examine the viability of the fetus and detect pathological conditions with a high level of accuracy. Consequently, ultrasonography has created new horizons in troubleshooting first trimester bleeding, whereby medical or surgical intervention can be administered on time and in targeted areas depending on the outcome of the ultrasonography.

Ultrasonographic diagnosis of the nature of the pregnancy, whether viable or not, with proper accuracy has serious implications in the management of the patients. The proper and early diagnosis of a viable pregnancy may help save the patient many hormonal therapy, lengthy hospital stay, and needless psychological trauma. On the other hand, early detection of non-viable pregnancies or abnormalities like ectopic pregnancy or molar pregnancy means early intervention hence avoiding morbidity and avoiding life threatening complications. Besides that, ultrasonography prevents unnecessary curettage and the risks of it, such as hemorrhage, uterine piercing, and septicemia. Ultrasound helps to reduce the complications caused by misdiagnosis and wrong therapy by guiding clinicians to the right and convenient time of managing the situation [6].

The other significant benefit of ultrasonography is that it is relatively feasible, unlike other types of imaging. Growth and proliferation of low-end ultrasound services can be more easily realized because of less physical infrastructure requirements, less expensive equipment, and less consumable needs [7]. These aspects render ultrasonography especially useful in resource-constrained areas, in which access to sophisticated diagnostic centers can be limited. Nevertheless, ultrasonography is not without limitations even though it has numerous benefits. Among the major weaknesses is that it is highly operator dependent where diagnostic accuracy depends on the expertise of a certain operator, method of work, training and experience [8]. This highlights the necessity to carry out proper training and standardization of ultrasound practices in order to provide reliable and reproducible outcomes.

There are several clinical uses of ultrasound examination in the first trimester. Confirmation of the intrauterine pregnancy, evaluation of pelvic pain, suspected ectopic pregnancy, confirmation of fetal cardiac activity and determination of the cause of vaginal bleeding are the most frequent signs [9]. Also, it is performed using ultrasonography to determine the gestational age, diagnosis or check the condition of a number of gestations and guide in procedures like chorionic villus sampling as well as embryo transfer. It is also used in the evaluation of some fetal anomalies including anencephaly in high-risk patients, the assessment of maternal pelvic masses or uterine malformations, in fetal aneuploidy screening programs, including the measurement of the nuchal translucency, and suspected hydatidiform mole. The nature of ultrasound as a versatile tool that can be used to answer a broad spectrum of diagnostic questions makes it an indispensable part of the care of pregnant women at the beginning of their pregnancy.

Sonography has a specific role of establishing whether a normal fetus is alive or not and, in the rule, out of other serious causes of first trimester bleeding like ectopic pregnancy, molar pregnancy and the presence of a high-risk pregnancy with excessive bleeding [10,11]. Through its ability to meaningfully visualize gestational structures and other related abnormalities, ultrasound helps clinicians to stratify risk, provide patients with the right type of counseling, and make additional management plans. As first trimester bleeding is extremely common, and its etiologies are diversified, the use of ultrasonography in daily assessment procedures is vital in enhancing diagnosis and patient outcome.

The current research is done to assess the importance of ultrasonography in proper diagnosis of the cause of first trimester bleeding and how it affects the management choice. The main goal is to evaluate the role of ultrasound in improving the accuracy of the diagnosis and changing the clinical decision-making process in the presence of the first trimester bleeding, thus, contributing to the minimization of the number of unwarranted interventions and the avoidance of unnecessary complications.

Methodology

Study Design: This study was designed as a prospective observational hospital-based study aimed at evaluating the role of ultrasonography in improving diagnostic accuracy and guiding clinical management in women presenting with first trimester bleeding.

Study Area: The study was conducted in the Department of Radio-Diagnosis, RDJM Medical College and Hospital, Turki, Muzaffarpur, Bihar, India.

Study Duration: The duration of the study was 6 months from April 2025 to September 2025

Sample Size: A total of 82 pregnant women presenting with bleeding per vaginum during the first trimester of pregnancy were included in the study.

Study Population: The study population comprised pregnant women in the first trimester (up to 12 completed weeks of gestation) who presented with complaints of vaginal bleeding and were referred from the Department of Obstetrics and Gynaecology to the Department of Radio-Diagnosis for ultrasonographic evaluation.

Inclusion Criteria

- Pregnant women presenting from the first day of last menstrual period up to 12 completed weeks of gestation
- Patients with complaints of bleeding per vaginum in the first trimester
- Patients who provided informed consent to participate in the study

Exclusion Criteria

- Women of reproductive age with missed periods and negative urine pregnancy test
- Patients who refused admission or ultrasonographic evaluation
- Patients with non-obstetrical causes of vaginal bleeding
- Pregnant women with gestational age more than 12 completed weeks

Data Collection: Data collection was carried out after obtaining informed consent from all eligible participants. Pregnant women presenting with bleeding per vaginum in the first trimester were referred from the Department of Obstetrics and Gynaecology to the Department of Radio-Diagnosis for ultrasonographic evaluation. A detailed clinical history including age, parity, gestational age based on last menstrual period, and presenting symptoms was recorded using a pre-structured proforma. Ultrasonographic examination was performed using transabdominal and/or transvaginal probes following standard imaging protocols. Findings such as the presence and location of the gestational sac, yolk sac, fetal pole, cardiac activity, adnexal masses, and free fluid were documented. Based on the ultrasound findings, cases were categorized into various diagnostic entities such as threatened abortion, missed abortion, incomplete abortion, ectopic pregnancy, and molar pregnancy. Follow-up ultrasonography was performed whenever clinically indicated, and the final diagnosis, management approach, and outcome were recorded for analysis.

Procedure: Eligible patients were enrolled after fulfilling inclusion criteria. A detailed history and clinical examination were conducted by the obstetrician. Ultrasonographic evaluation was then performed in the Department of Radio-Diagnosis.

Ultrasound findings were correlated with clinical diagnosis, and their impact on diagnostic accuracy and management decisions was assessed. Management decisions (conservative, medical, or surgical) were recorded and followed up where applicable.

Statistical Analysis: All collected data were entered into Microsoft Excel and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) software. Descriptive statistical methods were employed to summarize the data, including frequencies, percentages, means, and standard deviations where appropriate. The role of ultrasonography in establishing diagnosis and guiding management was assessed by analyzing the distribution of various ultrasonographic findings and their corresponding clinical outcomes. The results were presented in the form of tables and figures for clarity. A p-value of less than 0.05 was considered statistically significant wherever inferential statistics were applied."

Result

Table 1 compares clinical diagnosis with ultrasonography (USG) diagnosis among 82 cases. Ultrasonography identified threatened abortion (TA) as the most common diagnosis (36/82), of which 32 cases were clinically diagnosed correctly, while 4 were misclassified as incomplete abortion (IA). For incomplete abortion (IA), USG diagnosed 17 cases, with 12 correctly identified clinically, whereas 4 were misdiagnosed as TA and 1 as complete abortion (CA). Complete abortion (CA) showed notable discordance, with only 2 of 7 USG-diagnosed cases correctly identified clinically, while others were misclassified mainly as TA (3 cases) and IA (2 cases). All 5 cases of ectopic gestation (EG) diagnosed on USG were clinically suspected in only 3 cases, with 2 misdiagnosed as IA. Less frequent conditions such as inevitable abortion (In A), missed abortion (MA), and hydatidiform mole (HM) also demonstrated partial agreement, with correct clinical diagnosis in 2/3, 3/7, and 3/4 cases respectively. Overall, the table highlights variable concordance between clinical and USG diagnoses, with better agreement for threatened and incomplete abortions compared to other early pregnancy conditions.

Table 1: Comparison of Clinical Diagnosis with Ultrasonography Diagnosis (N = 82)								
USG Diagnosis	**CA**	**EG**	**IA**	**TA**	**In A**	**MA**	**HM**	**Total**
CA	2	0	2	3	0	0	0	7
EG	0	3	2	0	0	0	0	5
IA	1	0	12	4	0	0	0	17
TA	0	0	4	32	0	0	0	36
In A	0	0	1	0	2	0	0	3
MA	0	0	2	2	0	3	0	7
HM	0	0	0	1	0	0	3	4
Total	3	3	23	42	2	3	3	**82**

Table 2 shows the validity of clinical diagnosis when compared with the final diagnosis. For viable intrauterine pregnancy, there were 32 true positives, 10 false positives, 4 false negatives, and 36 true negatives, indicating a relatively high level of correct clinical identification. In non-viable intrauterine pregnancy, the clinical diagnosis yielded 20 true positives, 14 false positives, 16 false negatives, and 32 true negatives, reflecting a moderate diagnostic performance with a higher rate of misclassification. For ectopic pregnancy, the diagnosis was highly specific, with 3 true positives, no false positives, 2 false negatives, and 77 true negatives, demonstrating excellent ability of clinical assessment to correctly rule out ectopic pregnancy when absent

Table 2: Validity of Clinical Diagnosis with Final Diagnosis				
Parameters	**True Positive**	**False Positive**	**False Negative**	**True Negative**
Viable intrauterine pregnancy	32	10	4	36
Non-viable intrauterine pregnancy	20	14	16	32
Ectopic pregnancy	3	0	2	77

Table 3 presents the statistical evaluation of clinical diagnosis across different pregnancy outcomes. The diagnosis of viable intrauterine pregnancy demonstrated high diagnostic performance with a sensitivity of 89%, specificity of 78%, PPV of 76%, NPV of 90%, and an overall accuracy of 83%, showing strong statistical significance ($p < 0.001$). In contrast, non-viable intrauterine pregnancy showed comparatively lower diagnostic reliability, with sensitivity of 56%, specificity of 70%, PPV of 59%, NPV of 67%, and accuracy of 63%, though the result remained statistically significant ($p = 0.04$). The diagnosis of ectopic pregnancy exhibited excellent diagnostic validity, achieving 100% specificity and PPV, along with sensitivity of 60%, NPV of 97%, and accuracy of 98%, indicating a highly significant association ($p < 0.001$).

Table 3: Statistical Evaluation of Clinical Diagnosis						
Parameters	**Sensitivity (%)**	**Specificity (%)**	**PPV (%)**	**NPV (%)**	**Accuracy (%)**	**P value**
Viable intrauterine pregnancy	89	78	76	90	83	<0.001
Non-viable intrauterine pregnancy	56	70	59	67	63	0.04
Ectopic pregnancy	60	100	100	97	98	<0.001

Discussion

The current research results also support the critical role of ultrasonography in enhancing accuracy of the diagnosis and management in the case of first trimester bleeding. It was revealed that clinical assessment cannot reliably distinguish between different causes of early pregnancy bleeding, especially in non-viable intrauterine pregnancies and early pregnancy loss. The same has been regularly observed in the previous literature, in which history and pelvic examination were found to be less sensitive and specific because of similarity in clinical manifestations in the form of pain, bleeding, and uterine tenderness (Creinin et al., 2001; Mark et al., 2009) [1,4]. Ultrasonography by direct visualization of gestational location, viability and related adnexal findings, closes this diagnostic gap and enables management of the same in time and manner."

In the current research, the greatest cause of first trimester bleeding was abortions with 88.2 percent of cases, closely matched with the other studies carried out by Reddi Rani and Sunitha (2000) [12] and Rama Sofat (1987) [13] that asserted abortion as the major etiology. Nevertheless, the percentage of abortions in the present study was a little bit larger, and the ectopic pregnancy and hydatidiform mole were not so high. These differences can be explained by varied study population, patterns of referrals and accessibility to early ultrasonography. However, the fact that the studies are consistent highlights that conditions associated with abortion are the most important in the cause of early pregnancy bleeding, and

ultrasound is important in the accurate subclassification of such entities.

Another interesting observation of this study was the significant difference between the clinical and ultrasonographic diagnosis where only 65 cases were clinically diagnosed and confirmed on ultrasound, which indicated a difference of 36.2. This level of discordance is similar to that of Malhotra et al. (1987) [14] who also found that there were significant differences between clinical impressions and sonographic diagnoses but the difference in the present study was slightly bigger. Conversely, Reddi Rani and Sunitha (2000) [12] revealed a peonage smaller mismatch, which may have been as a result of variations in the experience of the clinicians or previous transvaginal sonography. These comparisons show that even the experienced clinicians can fail to classify early pregnancy complications without imaging to support them and especially in the differentiation of type of abortion and early ectopic gestation.

The diagnostic dilemma was particularly manifested in intra-uterine uterine non-viable pregnancies. In present research clinical diagnosis of non-viable intrauterine pregnancy showed moderate sensitivity (56) and accuracy (63) with a significant number of false positive and false negative. Chen and Creinin (2007) [3] also reported similar problems and stressed on the fact that the clinical evidence is usually slow to keep pace with the sonographic alterations observed in early pregnancy loss. Absence of cardiac activity, empty gestational sac or abnormal morphology of the sac are mere sonographic criteria that cannot be easily observed using clinical examination only (Paspulati et al., 2008) [2]. In this way, ultrasonography is decisive in minimizing the diagnostic uncertainty and avoiding overdiagnosis in addition to delayed intervention.

However, the clinical grounds of the diagnosis of viable intrauterine pregnancy in the current study were rather sensitive and specific despite the presence of false positives. This is in line with findings by Nyberg et al and Charles et al (2005) [15] who have reported that although clinical examination might indicate viability, ultrasound verification of fetal cardiac activity gives much better prognostic value. The 45 cases of threatened abortion found to be detected using ultrasound viability in the current study confirm the contribution of ultrasonography in informing conservative management and preventing unnecessary interventions which have been substantially confirmed in previous research (Dighe et al., 2008; Charles et al., 2005) [9,15].

In the current research, when compared to ultrasonographic results, Ectopic pregnancy was of superior specificity in addition to overall accuracy though with a smaller sensitivity. This great specificity is consistent with past reports that ultrasound, especially transvaginal sonography, is very effective in ruling out the possibility of ectopic pregnancy in the case that characteristic appearances are observed (Paspulati et al., 2004; Rumack et al., 2011) [2,5]. Yet, the incidence of false negative cases points to the fact that in really early cases of ectopic pregnancy, serial ultrasound and 2-hCG correlation may still fail to detect this pregnancy and that is why it is necessary to use them in previous studies (Levi, 2002; Hasan et al., 2009) [6,11]. There are no false positives in the given study which also supports ultrasound as the gold standard in ensuring ectopic gestation and proceeding with the surgical or medical necessary actions.

In the current research, the concordance between clinical and ultrasonographic diagnosis of hydatidiform mole, and missed abortion was low, which is also observed by previous literature of the non-specific clinical manifestation of the diseases (Mark et al., 2009) [4]. The ultrasound characteristics like snowstorm appearance in pregnancy of the molar or lack of embryonic development in missed abortion are diagnostic characteristics that are otherwise challenging to obtain clinically. The results of the current study are further confirmed by similar diagnostic enhancements with ultrasound by Reddi Rani and Sunitha (2000) [12] and Malhotra et al. (1987) [14].

All in all, the current research supports the existing literature on the fact that ultrasonography plays an important role in improving the quality of the diagnosis in the first trimester bleeding, especially when distinguishing between viable and non-viable intrauterine pregnancies and verifying the existence of ectopic gestation. Although clinical assessment is a mandatory step in the first place, use of clinical diagnosis can be used to misclassify and improperly treated. Introducing a new technique of ultrasonography into the routine assessment does not only enhance diagnostic accuracy but also better patient counseling, less needless interventions and earlier treatment, thus enhancing maternal outcomes in early pregnancy complications.

Conclusion

The paper has proven that ultrasonography remains vital to enhance diagnostic accuracy in women who present with first trimester bleeding by surmounting the shortcomings of clinical evaluation. There was significant overlap and misclassification of several different causes of early pregnancy bleeding on clinical diagnosis but ultrasonography offered a clearer distinction of viable and non-viable intrauterine pregnancies, ectopic pregnancies, and other pathological causes. The results indicate that the use of clinical assessment alone may result in diagnosis ambiguity and improper treatment, especially in diseases that have similar manifestations. Ultrasonography did not only improve diagnostic accuracy but

also provided favorable and prompt clinical decisions, which lessened the chance of missed or late diagnosis. Comprehensively, the research highlights ultrasonography as a valuable, practical, and vital instrument in the assessment and management of first trimester bleeding as one of the factors in enhancing maternal care and maternal outcomes.

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