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Diagnostic accuracy of ultrasound versus MRI in the evaluation of placenta previa and its variants: A multicentric retrospective cross-sectional study.

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Abstract

Background

Placenta previa is a major cause of maternal morbidity. Ultrasound (US) is first-line, but MRI is often used when findings are equivocal or high-risk features are present.
Objective: To compare the diagnostic accuracy of US and MRI in detecting placenta previa and classifying its variants.

Methods

A retrospective study was conducted over 18 months at two tertiary centers (Narayan Medical College & Hospital, Jamuhar, and RNT Medical College, Udaipur). A total of 120 women who underwent both obstetric US and MRI during pregnancy and subsequently delivered at either center were included. Delivery findings were taken as the reference standard.

Results

Placenta previa was confirmed in 48/120 (40%) women. US achieved sensitivity 87.5%, specificity 90.3%, PPV 85.7%, NPV 91.5%, and accuracy 89.2%. MRI demonstrated sensitivity 93.8%, specificity 91.7%, a PPV 88.2%, NPV 95.7%, and accuracy 92.5%. McNemar's test showed no statistically significant difference between modalities. MRI demonstrated higher concordance in classifying variants (85% vs 75% for US; weighted κ 0.82 vs 0.72). Interobserver agreement was good for both modalities (US κ=0.78; MRI κ=0.83).

Conclusion

Both US and MRI showed high accuracy for placenta previa. MRI provided modestly superior sensitivity and variant classification, especially in posterior placenta and prior cesarean cases.

Recommendation

MRI should be used selectively in cases with posterior placenta, prior cesarean section, or inconclusive ultrasound findings to improve diagnostic confidence and surgical planning.

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Introduction

Placenta previa, in which the placenta implants in the lower uterine segment and partly or completely covers the cervical os, is a major contributor to antepartum hemorrhage and adverse pregnancy outcomes [1]. Women affected by this condition often present with painless vaginal bleeding in late pregnancy and face increased risks of operative delivery, postpartum hemorrhage, and blood transfusion. Infants born to these mothers are more likely to be preterm, of low birth weight, and to require neonatal intensive care. The

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prevalence is estimated at 0.3–0.5% of pregnancies, but the burden is higher in referral hospitals. Advanced maternal age, multiparity, prior uterine surgery, and assisted reproduction are recognized risk factors, with previous cesarean section being particularly important because it not only predisposes to placenta previa but also raises the likelihood of placenta accreta spectrum disorders[2,3,4].

Ultrasound remains the primary imaging technique for evaluating placental location. Transabdominal scanning serves as the initial approach, while transvaginal sonography is considered the standard for confirming or excluding placenta previa due to its ability to measure the placental edge–internal os distance with high precision. Ultrasound is widely accessible, safe, and economical, with diagnostic accuracy exceeding 90% in many studies. However, limitations are encountered when the placenta is posterior, when maternal body habitus interferes, or when fetal position obscures the cervical region. In addition, sonographic features suggesting abnormal adherence may be subtle or inconclusive, creating uncertainty in surgical planning [5,6,7].

Magnetic resonance imaging provides multiplanar views and high soft-tissue contrast that can overcome several of the challenges faced by ultrasound. It offers a broader field of assessment of the placenta and surrounding pelvic structures, allowing better evaluation of placental location and depth of invasion when present. MRI is particularly useful in cases with posterior placenta or where cesarean scars distort anatomy. Although some reports suggest superior accuracy of MRI in variant classification and detection of the accreta spectrum, others show that well-performed transvaginal ultrasound achieves comparable results. Cost, limited availability, and the need for specialized expertise restrict the routine application of MRI, highlighting the need for clearer evidence to guide its selective use [8,9].

To address this gap, the present multicentric retrospective study was undertaken at Narayan Medical College and Hospital, Jamuhar, and RNT Medical College, Udaipur. Over 18 months, 120 women who underwent both ultrasound and MRI and subsequently delivered at these centers were analyzed, with delivery records serving as the reference standard. The study aimed to determine and compare the diagnostic accuracy of ultrasound and MRI for placenta previa, to assess their performance in classifying its variants, and to evaluate interobserver agreement. Subgroup analysis according to placental site and history of prior cesarean section was also performed. This work provides real-world data from two tertiary institutions in India, contributing to evidence-based recommendations on the optimal use of imaging in suspected placenta previa[10,11].

Materials and methods

Study design and setting

This was a multicentric retrospective cross-sectional study conducted at Narayan Medical College & Hospital, Jamuhar (Bihar, India), and RNT Medical College, Udaipur (Rajasthan, India), from January 2023 to June 2024

Participants

Inclusion

- Singleton pregnancies undergoing both US and MRI with delivery records available.

Exclusion

- Multiple gestations, major fetal anomalies, imaging >8 weeks before delivery, incomplete records.

Sample size

Sample size was calculated using the formula for diagnostic studies:

$n = Z^2 \times [P(1-P)] / d^2$

Where Z = 1.96 at 95% confidence interval, P = expected sensitivity (assumed 90% based on previous studies), and d = margin of error (5%).

The minimum required sample size was approximately 110. To account for incomplete records, 120 participants were included.

Imaging modalities

Ultrasound: Transabdominal ± transvaginal; placental edge–internal os distance measured; variant classification per standard definitions.

MRI: T2-weighted and T1 sequences; variant classification using identical taxonomy.

Two blinded radiologists reviewed each modality independently.

Ethical consideration

Ethical approval was obtained from the Institutional Ethics Committee of Narayan Medical College & Hospital, Jamuhar, and RNT Medical College, Udaipur.

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Reference standard

Diagnosis of placenta previa and variant at delivery (operative notes and obstetric records).

Statistical analysis

Sensitivity, specificity, predictive values, accuracy, and 95% CIs were calculated. Paired comparisons used McNemar's test. Agreement with reference and interobserver reliability was assessed with weighted κ.

Results

A total of 120 women were included in the analysis, with 60 cases from Narayan Medical College and Hospital, Jamuhar, and 60 from RNT Medical College, Udaipur. The mean maternal age was 28.6 years (range 21–39). Forty-six women (38.3%) had a history of previous cesarean section, and 12 (10%) had undergone other uterine surgery. Placental location was anterior in 64 (53.3%) and posterior in 56 (46.7%). Placenta previa was confirmed at delivery in 48 women (40%). Among these, 12 (25%) had low-lying placenta, 10 (20.8%) had marginal placenta previa, 9 (18.7%) had partial previa, and 17 (35.5%) had complete previa.

Diagnostic performance of ultrasound and MRI

Ultrasound correctly identified placenta previa in 42 of 48 cases, yielding a sensitivity of 87.5%. Specificity was 90.3%, with 65 true negatives and 7 false positives. The overall accuracy was 89.2%. MRI demonstrated slightly higher accuracy, with 45 true positives and 66 true negatives, corresponding to a sensitivity of 93.8% and a specificity of 91.7%. The overall accuracy for MRI was 92.5%.

When compared using McNemar's test, MRI showed a greater number of correct classifications compared with ultrasound ($b = 8$, $c = 4$), although this difference did not reach statistical significance ($p > 0.05$).

Variant classification

Among the 48 women with placenta previa at delivery, ultrasound correctly classified the variant in 36 cases (75%), while MRI achieved correct classification in 41 cases (85%). Weighted kappa agreement with delivery findings was 0.72 for ultrasound and 0.82 for MRI, indicating substantial and almost perfect agreement, respectively.

Interobserver agreement

Double reading was available in 50 randomly selected cases. Agreement between two sonologists for ultrasound diagnosis was substantial ($\kappa = 0.78$), whereas agreement between two radiologists for MRI was slightly higher ($\kappa = 0.83$).

Subgroup analysis

Anterior placenta ($n = 64$): Ultrasound sensitivity was 86%, while MRI reached 94%.

Posterior placenta ($n = 56$): Ultrasound sensitivity was 88%, MRI 94%.

Prior cesarean section ($n = 46$): Ultrasound sensitivity 88%, MRI 95%.

These findings suggest that MRI offered additional diagnostic confidence, particularly in posterior placentas and in women with prior cesarean deliveries.

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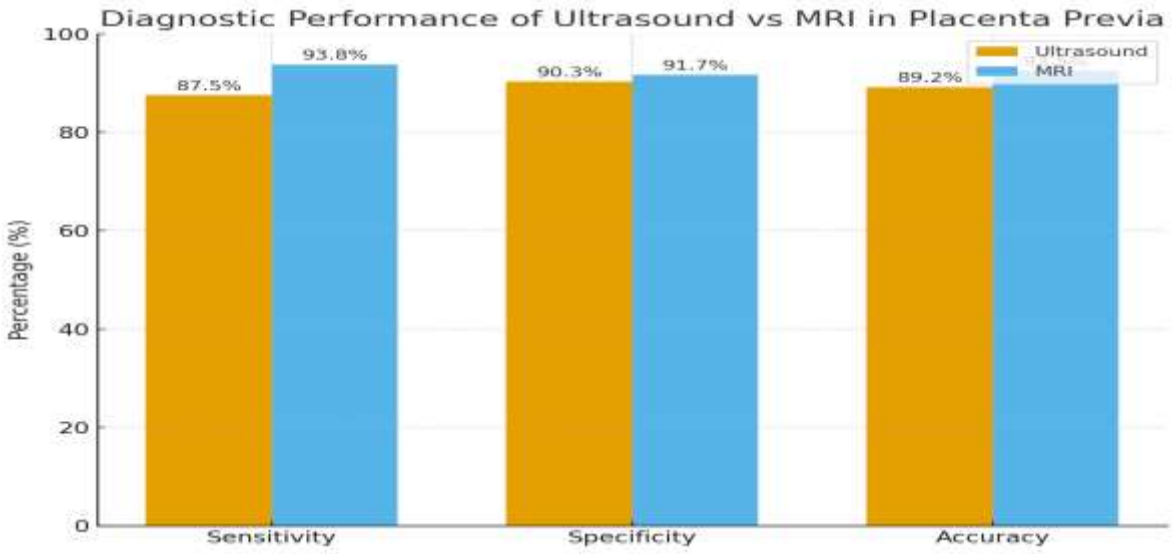

Figure 1. Diagnostic accuracy of ultrasound and MRI compared with the delivery diagnosis

Table 1. Diagnostic performance of ultrasound and MRI (n = 120)

Modality	True Positive	False Negative	True Negative	False Positive	Sensitivity (%)	Specificity (%)	Accuracy (%)
Ultrasound	42	6	65	7	87.5	90.3	89.2
MRI	45	3	66	6	93.8	91.7	92.5

Table 2. Variant classification accuracy (n = 48 with placenta previa at delivery)

Variant	Cases at Delivery (n)	Correct by US (n, %)	Correct by MRI (n, %)
Low-lying	12	8 (66.7%)	10 (83.3%)
Marginal	10	7 (70.0%)	8 (80.0%)
Partial	9	6 (66.7%)	7 (77.8%)
Complete	17	15 (88.2%)	16 (94.1%)
Total	**48**	**36 (75.0%)**	**41 (85.4%)**

Discussion

This multicentric retrospective study assessed the diagnostic accuracy of ultrasound and MRI in women with suspected placenta previa, using delivery findings as the standard of reference. Across 120 cases from two tertiary hospitals, both imaging modalities performed well. Ultrasound achieved an accuracy close to 90%, while MRI showed slightly better results, with an accuracy of over 92%. Although MRI yielded higher sensitivity and better variant classification, the difference from ultrasound was not statistically significant. These findings confirm that ultrasound remains highly reliable, while MRI has a complementary role when additional detail is required [12].

Ultrasound successfully identifies the majority of previa cases and remains the most practical investigation in everyday obstetric practice. It provided excellent negative predictive value, reducing unnecessary interventions when the placental edge was safely away from the internal os. The few missed cases in our cohort occurred mostly in women with posterior placentas, reflecting technical limitations such as acoustic shadowing and restricted cervical visualization. These limitations are widely recognized,

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highlighting the need for caution when sonographic views are suboptimal [13].

MRI offered greater clarity in circumstances where ultrasound was less reliable. It correctly classified more variants and provided reproducible measurements of placental margins. The ability to visualize the lower uterine segment in multiple planes made it particularly valuable in posterior placentas and in patients with previous cesarean scars. Precise identification of complete versus partial coverage is clinically important because it influences surgical planning and anticipated blood loss. In our series, MRI improved confidence in such high-risk situations, even if the incremental gain over ultrasound was modest [14,15].

When compared with earlier reports, the results are consistent with the international experience. Previous studies have shown that transvaginal ultrasound alone achieves high accuracy, with MRI reserved for problem-solving. Some investigators have suggested that MRI provides additional information on depth of invasion in suspected accreta spectrum, though this was not the primary focus of our work. The data, collected from two geographically and demographically distinct centers, provide supportive evidence that the same diagnostic principles apply in the Indian setting[16].

Observer agreement in this study was strong for both modalities, though marginally higher for MRI. This suggests that experienced radiologists and sonologists can reliably interpret imaging features, but MRI offers additional reproducibility when opinions differ. Subgroup analyses further emphasized the usefulness of MRI in posterior placenta and in women with prior cesarean deliveries, groups where surgical risk is greatest. These observations reinforce a selective imaging strategy, whereby MRI is used to clarify difficult or high-risk cases rather than as a universal tool[17].

The strengths of this work include its multicentric design, which allowed evaluation across two large referral hospitals, and the use of operative findings as the definitive reference. The sample size was adequate compared with many previous reports, and variant classification as well as interobserver reliability were both assessed, providing a comprehensive perspective. However, several limitations must be considered. The retrospective design carries the possibility of referral bias, since women sent for MRI may have represented more complex cases. Intervals between imaging and delivery were not uniform, and placental position may have changed in some pregnancies. Protocols differed slightly between centers, which could have influenced performance, and subgroup analyses were not powered for statistical significance[18].

In conclusion, both ultrasound and MRI demonstrated high accuracy for the diagnosis of placenta previa in this study. Ultrasound should remain the first-line investigation due to its accessibility and proven reliability, while MRI can be reserved for specific indications such as posterior placenta, prior cesarean section, or equivocal sonographic findings. A selective approach ensures efficient use of resources while maintaining diagnostic confidence.

Generalizability

The findings of this study are generalizable to tertiary care settings, particularly in resource-limited countries like India, where ultrasound is widely available and MRI is used selectively for complex cases.

Limitations

The retrospective design may introduce selection bias. Variation in imaging protocols across centers and non-uniform intervals between imaging and delivery may have influenced diagnostic accuracy. Subgroup analyses were not adequately powered.

Recommendation

Ultrasound should remain the first-line modality. MRI should be reserved for equivocal cases, posterior placenta, and patients with prior cesarean sections. Future prospective studies with standardized imaging protocols are recommended.

Conclusion

In this multicenter retrospective study including 120 women, both ultrasound and MRI proved highly reliable for the diagnosis of placenta previa when verified against delivery findings. Ultrasound reached a sensitivity of 87.5% with an overall accuracy of 89.2%. MRI demonstrated slightly higher performance, with a sensitivity of 93.8% and an accuracy of 92.5%, and offered clearer delineation of variants and stronger interobserver agreement. The incremental advantage of MRI was most evident in posterior placentas and in women with previous cesarean sections, although the difference compared with ultrasound was not statistically significant.

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List of abbreviations

US – Ultrasound
MRI – Magnetic Resonance Imaging
PPV – Positive Predictive Value
NPV – Negative Predictive Value

Source of funding

This study received no external funding.

Conflict of interest

The authors declare no conflict of interest.

Availability of data

Data supporting the findings are available from the corresponding author upon reasonable request.

Author contributions

Dr. Meenal Chugh – Study design, manuscript writing
Dr. Kalpana Chugh – Data interpretation, supervision
Dr. Vismandeep Kaur Sandhu – Data collection, analysis

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