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Comparative Diagnostic Accuracy of Ultrasound and Magnetic Resonance Imaging in Placenta Accreta Spectrum Disorder: An experience from a tertiary care centre

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ABSTRACT

Objective: This study aims to prospectively evaluate and compare the diagnostic performance of ultrasound (US) and magnetic resonance imaging (MRI) in women at high risk for Placenta Accreta spectrum (PAS) disorder and to assess their complementary roles in clinical management.
Methods: In this prospective observational study, 30 pregnant women with suspected PAS disorder were evaluated between 18 and 35 weeks of gestation. All patients underwent both transabdominal ultrasound with color Doppler, followed by MRI. Imaging findings were compared to intraoperative findings and histopathological diagnoses. Histopathological diagnosis was considered the gold standard.
Results: The ages of patients ranged from 22 to 41 years. Out of the total 30 patients, 27 were confirmed to have PAS (20 accreta, 4 increta, 3 percreta). On correlation of US and MRI diagnosis with intraoperative and histopathological findings, US has a sensitivity of 92.6%, a specificity of 100%, a positive predictive value of 100% but a negative predictive value of 60%. Accuracy of US against intraoperative findings was 93.3%. However, MRI was false positive in one case; consequently, MRI had a sensitivity and specificity of 96.7% and 100% respectively. MRI had a positive predictive value of 100% but a negative predictive value of 75%. The accuracy of MRI against intraoperative findings was 96.7%. MRI was superior in detecting posterior placentation and parametrial invasion.
Conclusion: Both US and MRI are valuable tools for diagnosing PAS, with MRI showing marginally higher sensitivity, especially in complex or posterior cases. A combined approach enhances diagnostic confidence and surgical planning, potentially improving maternal outcomes.

Keywords*: Ultrasound(US), Magnetic resonance imaging(MRI), placenta accreta spectrum (PAS).*

INTRODUCTION

Placenta Accreta Spectrum (PAS) disorders represent a range of abnormal adherence of the placenta to the uterus with subsequent failure to separate after delivery of the fetus. Placental trophoblastic cells have tissue invasive characteristics similar to malignant cells.(1) When trophoblastic villi burrow into an area of poorly developed or absent decidua, placenta accreta occurs. The types of accreta varies according to the depth of invasion. These abnormalities of placental attachment are defined as villi penetrate the decidua but not the myometrium (accreta); villi penetrate and invade into the myometrium but not the serosa (increta); villi penetrate through the myometrium and may perforate the serosa, sometimes into adjacent organs (percreta).(1)

The prevalence is estimated to be 1 in 2500 pregnancies, but in women with placenta previa , the prevalence is nearly 10%. The most predisposing conditions are previous cesarean section and placenta previa. It has been found that in the setting of anterior placenta previa, the risk of placenta accrete increases from 24% in women with 1 prior caesarean delivery to 67% in women with three or more prior cesareans.(2)

Careful assessment of such at risk pregnancies is warranted because this condition may lead to massive obstetric hemorrhage. Prenatal diagnosis allows effective delivery management planning to minimize morbidity. Ultrasound remains the first-line imaging modality due to its wide availability and cost-effectiveness. However, its accuracy may be limited by patient body habitus, placental location, and operator expertise. MRI offers superior soft tissue contrast and multiplanar capabilities, potentially enhancing detection in equivocal or complex cases.

AIMS AND OBJECTIVES

This study aims to prospectively evaluate and compare the diagnostic performance of ultrasound and MRI in women at high risk for PAS and to assess their complementary roles in clinical management.

METHODS

Study Design and Population

This prospective observational study was conducted at a tertiary care center from January 2022 to June 2025.
Inclusion criteria included pregnant women >18 years of age with risk factors for PAS: previous cesarean section, placenta previa, or uterine surgeries.

Exclusion criteria were contraindications to MRI and incomplete follow-up.

MATERIAL AND METHODS

This study was conducted in a tertiary care hospital. The study comprised 30 patients suspected of having placenta accreta spectrum disorder, with a history of previous caesarean sections, and now presented with placenta praevia.

Patients were evaluated for presenting complaint, followed by imaging evaluation. Patients having claustrophobia, metallic implants like stents, heart valves, hearing aids, bony prosthesis, etc., which are not compatible with MRI, were excluded from the study.

The imaging protocol includes ultrasound and Doppler examination of the pelvis, followed by MRI examination.

Imaging evaluation-
Ultrasonography and colour doppler- obstetrics ultrasound were performed on Philips Affinity 70 g machine using a 1-5 MHz curvilinear transducer. Both grayscale and Doppler evaluations were done in the same setting. Few patients with advanced gestation were also evaluated with transperineal sonography for a better assessment of the placenta and urinary bladder interface.

MRI examination was performed in GE 1.5 T SIGNA explorer (16 channel) using a multichannel phased–array surface coil. The urinary bladder was kept partially full for assessment of bladder invasion. To minimise motion artifacts, fast sequences were acquired. MRI protocol included a localizer scan followed by breath-holding techniques used to minimise motion artefact. Single-shot T2-weighted echo-planar fast spin-echo sequences in multiple planes were acquired.

Statistical analysis

SPSS software (version 22.0; IBM, SPSS, Chicago, USA) was used for all statistical analyses in this study. The sensitivity (Se), specificity (Sp), positive predictive value (PPV), and negative predictive value (NPV) were calculated for both sonography and MRI. The Se and Sp values of sonography and MRI were compared by means of the McNemar test. Se, Sp, PPV and NPV were calculated for each evaluated ultrasound and MRI feature. A p value < 0.05 was considered statistically significant.

RESULTS

Age of patients ranged from 22 to 41 years. Mean age of patients was 31.23±4.60 years (Median age 31 years; interquartile range 28-34 years). The obstetric and relevant clinical profile has been shown in Table 1. On USG, abnormal intraplacental lacunae (n=29), loss of retroplacental clear space (n=27) and myometrial thinning (n=24) were the most common abnormalities while irregular bladder wall/bladder wall interruption (n=18), bridging vessels (n=17) and focal exophytic mass (n=12) were the least common USG abnormalities. On USG, a total of 27 (90%) cases were diagnosed as PAS (Table 2; Fig. 1 and Fig. 3).

On MRI, heterogenous placenta and intraplacental T2 dark band (n=27 each), myometrial thinning (n=25) and loss of T2 hypointense retroplacental line (n=24) were the most common abnormalities, while abnormal vascularization of placental bed (n=21), bladder wall interruption (n=16) and focal exophytic mass (n=10) were the least common MRI abnormalities.

MRI diagnosis of PAS was made in 26 (86.7%) cases (Table 2; Fig. 2). Intraoperatively, a total of 27 (90%) cases were diagnosed as PAS – 20 (66.7%) placenta accreta, 3 (10.0 %) placenta increta and 4(13.3%) placenta percreta respectively (Table 2, Fig 2 and 4).

On correlation of USG and MRI diagnosis with intraoperative findings, USG has a sensitivity of 92.6%, a specificity of 100%, a positive predictive value of 100% but a negative predictive value of 60%. Accuracy of USG against intraoperative findings was 93.3% (Table 3a). However, MRI was false positive in one case; consequently, MRI had a sensitivity and specificity of 96.7% and 100% respectively. MRI had a positive predictive value of 100% but a negative predictive value of 75%. Accuracy of MRI against intraoperative findings was 96.7% (Table 3b).

Table 1: Demographic, Obstetric and relevant clinical Profile of Study Population

SN	Characteristic	Statistic
1.	Mean age ± SD (Range) Median [Interquartile range]	31.23±4.60 (22-41) 31 [28, 34]
2.	Parity 1 2 3	 23 (76.7%) 6 (20.0%) 1 (3.3%)
3.	No. of previous caesarean sections 1 2 3	 25 (83.3%) 4 (13.3%) 1 (3.3%)
4.	Gestational age at presentation ≤24 weeks 24-28 weeks 28-32 weeks 32-36 weeks	 8 (26.7%) 3 (13.3%) 8 (26.7%) 10 (33.3%)
5.	Location of placenta Anterior Posterior	 26 (86.7%) 4 (13.3%)
6.	Grade of placenta previa 1 2 3 4	 1 (3.3%) 2 (6.7%) 20 (66.7%) 7 (23.3%)

Table 2: USG, MRI and Intraoperative Findings

SN	Diagnosis	Number of cases	Percentage
1.	USG Diagnosis PAS No PAS	 25 5	 83.3 16.6
2.	MRI Diagnosis PAS No PAS	 26 4	 86.7 13.3
3.	Intra-operative findings PAS Placenta accreta Placenta increta Placenta percreta No PAS	 27 20 3 4 3	 90.0 66.7 10.0 13.3 10.0

Table 3: Correlation of Intraoperative Findings with USG and MRI findings

(a) Intraoperative vs USG

USG Findings	Intraoperative		Total
	PAS	No PAS	
PAS	25	0	25
No PAS	2	3	5
Total	27	3	30

κ=0.813; p<0.001

Sensitivity	Specificity	PPV	NPV	Accuracy
92.6	100	100	60	93.33

(b) Intraoperative vs MRI					
MRI Findings	**Intraoperative**			**Total**	
	PAS		**No PAS**		
PAS	26		0	26	
No PAS	1		3	4	
Total	27		3	30	
κ=0.839; p<0.001					
Sensitivity	Specificity	PPV	NPV	Accuracy	
96.3	100	100	75	96.3	

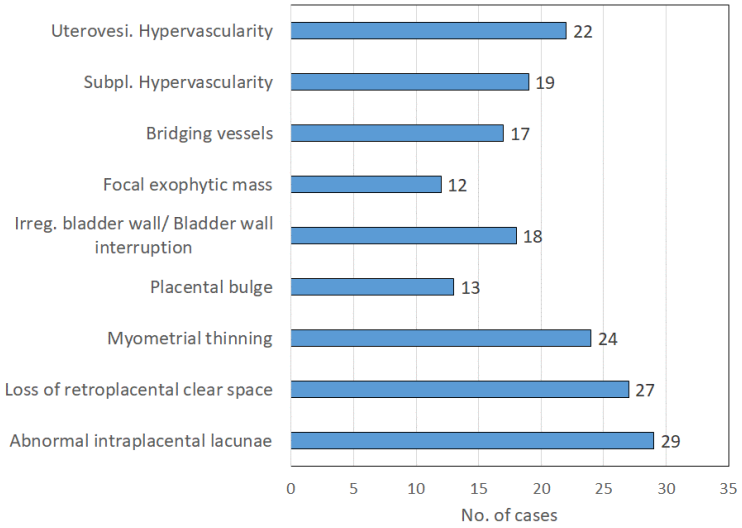

Fig. 1: USG Findings

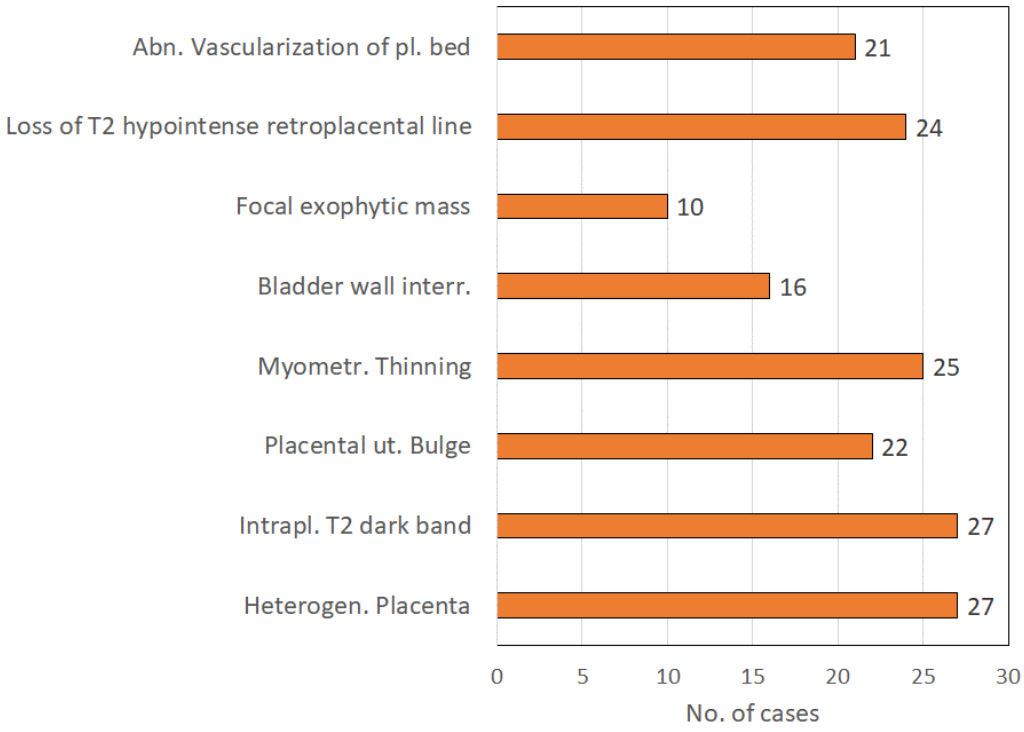

Fig. 2: MRI Findings

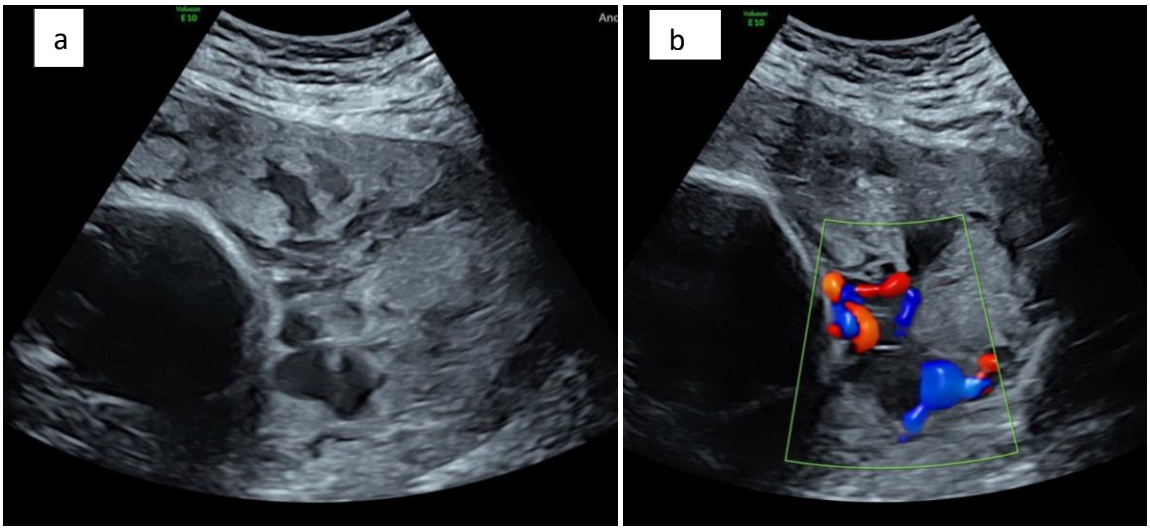

Fig 3(a) Transverse transabdominal sonography shows multiple tortuous irregular anechoic spaces within the placenta suggesting placenta lacunae. (b) Some lacunae shows typical high velocity turbulent lacunar flow

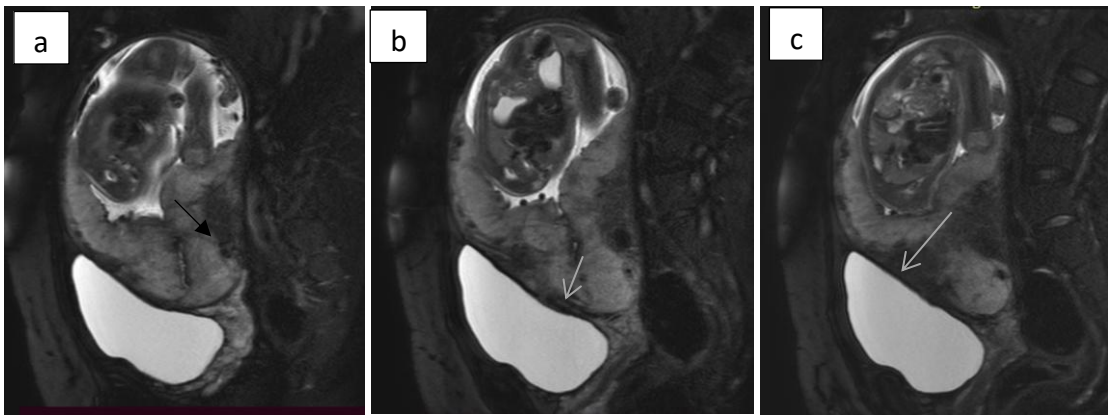

Fig 4(a) A case of placenta percreta showing placental heterogeneity, dark interplacental bands and interplacenta hemorrhages (solid black arrow), (b) focal loss of uterine serosa (white arrow) and (c) focal indentation on posterior wall of urinary bladder (white arrow).

DISCUSSION

The diagnosis of PAS disorder is based on US, and the sonographic features of placenta accreta have been described. These include irregularly shaped placental lacunae (vascular spaces) with turbulent internal flow shown by Doppler, thinning of the myometrium overlying the placenta, loss of retroplacental hypoechoic "clear" zone, absence of a decidual interface with normal placental echogenicity, interruption or increased vascularity of the uterine serosa – posterior bladder wall interface, and apparent bulging or protrusion of the placenta into the bladder (Fig.1 and 3). The prominent or multiple hypoechoic-anechoic irregular spaces (lacunae) in the placenta may result in a moth-eaten or swiss cheese appearance of the placenta. (3)

The appearance of loss of retroplacental clear space is commonly thought to be associated with placenta accreta. In placenta accreta, this normally hypoechoic, 1-to 2 cm band is absent or markedly thinned (<2mm), and there may be loss of the normal decidual interface between the placenta and myometrium. (4) This finding is not sensitive, and it may not always be a reliable diagnostic sign because false positive results do occur. (5) Comstock CH et al. have reported that the presence of placental lacunae is the most predictive sonographic sign of accreta, with a sensitivity of 93% in the 15 to 40 week range, which is in concordance with our study. (5)

In addition to grayscale US findings, targeted Doppler assessment should be performed, and, at times, MRI is considered in this evaluation because it may provide additional diagnostic information in equivocal cases or when the placenta is posterior in location.(4,6,7) So MRI act as a problem-solving tool. The gold standard for the diagnosis of placental accreta spectrum disorder is postoperative histopathological findings.

Thus, a two-stage imaging protocol to evaluate women at high risk for placenta accreta, using USG followed by MRI, was used in our study. In our study, 30 patients suspected of having PAS were enrolled; each patient underwent surgical hysterectomy. Intraoperative findings were taken as the gold standard, and MRI findings were compared.

Many studies have compared ultrasound and MRI for the diagnosis of PAS (reference diagnostics article). In our study, USG has a sensitivity of 92.6%, a specificity of 100%, a positive predictive value of 100% but a negative predictive value of 60%. Accuracy of USG against intraoperative findings was 93.3%. However, MRI was false positive in one case; consequently, MRI had a sensitivity and specificity of 96.7% and 100% respectively. MRI had a positive predictive value of 100% but a negative predictive value of 75%. The accuracy of MRI against intraoperative findings was 96.7%. The findings of our study underscore the utility of both ultrasound and MRI in the prenatal diagnosis of PAS. While ultrasound offers excellent specificity and is readily accessible, MRI adds value in complex or equivocal cases, particularly for posterior placenta and deeper invasions like increta and percreta.

Three recently published meta-analyses have considered the accuracy of ultrasound for the diagnosis of invasive placentation [8], the use of MRI [9] and a comparison of ultrasound and MRI [10] D'Antonio et al [8,9] reported a sensitivity of 90.7% for ultrasound and 94.4% for MRI, and a specificity of 96.9% for ultrasound and 84% for MRI. Meng et al [10] showed that ultrasound sensitivity was 83%, and its specificity was 95%, compared with 82% and 88%, respectively, for MRI. These studies show results that are in concordance with our study. These meta-analyses showed good accuracy of ultrasound and MRI in the diagnosis of placental invasion. The results are only applicable to women with placenta previa and a history of a caesarean delivery or uterine surgery.

These meta-analyses reported that ultrasound and MRI are equally accurate in diagnosing the presence of invasive placentation. We found a statistically significant difference in sensitivity between MRI and US, but no difference in specificity or in the percentage of correct diagnoses. This statistical difference might have arisen because only when the placenta was suspected to be adherent on ultrasound was the patient referred for MRI, thus increasing the specificity of MRI and decreasing its sensitivity. No difference in specificity is in concordance with our study.

Several authors found a better performance of MRI compared to ultrasound to diagnose placenta accreta when the placenta has a posterior attachment [11–14].

A study by Riteau et al. found that there was no significant difference in accuracy between ultrasound (USG) and MRI in diagnosing placenta accreta spectrum disorder, with both modalities showing high accuracy (USG 88%, MRI 94-100%) for detecting placental invasion**.** (15)

In our study performance of two imaging techniques used in the prenatal diagnosis of placenta accreta in the same patient population was evaluated. The accreta or percreta characteristic of the placenta was based on pathological examination, which is more reliable than intraoperative surgical findings. It also specifies the diagnostic value of each feature for both imaging techniques.

Previous studies have shown variable results, but our study reinforces the complementary nature of both tools, advocating a stepwise approach where MRI is reserved for inconclusive or high-risk ultrasound findings.

CONCLUSION

Ultrasound and MRI are both effective in diagnosing PAS, with MRI showing an edge in detecting severe or posterior cases. In centres where MRI is available, its adjunctive use in high-risk pregnancies can refine diagnosis and improve preoperative preparation. A multidisciplinary approach combining imaging expertise and clinical acumen remains key to optimal PAS management.

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