Section: Radiodiagnosis

Original Research Article

UTILITY OF ULTRASOUND WITH COLOUR DOPPLER AND MAGNETIC RESONANCE IMAGING IN PRENATAL DIAGNOSIS OF PLACENTA ACCRETA IN PATIENTS WITH PLACENTA PREVIA

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Abstract

Background: Placenta accreta is the abnormal adherence of the placenta to the uterine wall and the most common cause of emergency postpartum hysterectomy. The present study aimed to study ultrasound with colour Doppler (CDUS) and magnetic resonance imaging (MRI) in prenatal diagnosis of placenta accreta in patients with placenta previa. **Materials and Methods:** This cross-sectional study was done for two years, from October 2019 to September 2021, at the Department of Radiology, Government Tirunelveli Medical College, a tertiary care hospital. Sixty-six pregnant women fulfilling the inclusion criteria were selected. Participants were evaluated with CDUS and MRI and followed up until delivery. The placenta was considered normal when the delivery of the placenta was easy without bleeding complications. Diagnosis of placenta accreta was made when the placenta delivery was difficult. **Result:** The USG evaluation of patients showed that loss of sub-placental clear space with maximum sensitivity (84.62%), irregular bladder wall, vascularisation perpendicular to the myometrium, and bladder wall vascularisation with maximum specificity, each with 97.5%. PPV was reported highest with vascularisation perpendicular to myometrium and bladder wall vascularisation, each with 90.91%. Loss of retroplacental clear space was observed with the highest NVP (88.57%). The MRI evaluation of all patients revealed the thinning of the myometrium with the highest sensitivity (73.08%), placental heterogeneity with maximum specificity (92.5%) and PPV (76.92%). Whereas NPV was found to be maximum with thinning of the myometrium (80.56%). **Conclusion:** In the present study, MRI was more sensitive and specific than USG in detecting the adherent placenta.

INTRODUCTION

Placenta accreta refers to abnormal placentation in which chorionic villi attach directly to or invade the myometrium. It is a significant cause of maternal morbidity and mortality and is now the most common indication for emergency postpartum hysterectomy.[1] Its prevalence has risen multi-fold over the past years, primarily due to the increasing percentage of pregnant patients undergoing primary and repeat caesarean sections. Two studies in the United States suggest a prevalence of 1 in 2500 deliveries, with both studies using clinical and pathologic diagnoses.[2] Several studies from the United States and abroad suggest a higher prevalence of about 1 in 500 deliveries.[3-4]

Though there are no published data regarding the incidence or prevalence of placenta accreta in the Indian population, retrospective analysis of data from our institute also demonstrated a similar rise in its incidence. There were 20,735 deliveries from January 2009 to September 2012, with ten confirmed cases of placenta accreta, making an incidence of 1/2073. The incidence has increased from 1/5647 deliveries in 2009 to 1/969 deliveries in 2012.

The clinical consequence of placenta accreta is massive bleeding during placental separation. This massive bleeding may be associated with severe

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complications like disseminated intravascular coagulopathy, renal failure, and adult respiratory distress syndrome and may even result in a patient's death. Emergency hysterectomy is the final resort and may result in associated complications like injury to the ureter or urinary bladder and pulmonary embolus.[5]

Accurate prenatal diagnosis of placenta accreta is crucial for appropriate patient management. Based on this diagnosis, the patient is planned for delivery at a tertiary care setup with facilities for anaesthesia and surgery. The caesarean section is planned electively before 37 weeks of gestation to prevent spontaneous labour.[6]

Identifying and managing placenta accreta is a clinical and diagnostic challenge with increasing frequency. Clinicians should be aware of the clinical issues and risk factors, and radiologists with imaging protocol and findings associated with it to facilitate optimal case management.

The present study aims to evaluate the role of colour Doppler ultrasonography (CDUS) and magnetic resonance imaging (MRI) in antenatal diagnosis of placenta accreta in patients with placenta previa.

MATERIALS AND METHODS

This cross-sectional study was done for two years, from October 2019 to September 2021, at the Department of Radiology, Government Tirunelveli Medical College, a tertiary care hospital. Sixty-six pregnant women fulfilling the inclusion criteria were selected for the study. Institutional ethical committee approval and written consent were taken before the start of the study.

Pregnant women diagnosed with placenta previa with or without a history of previous uterine surgeries like caesarean section or gynaecological surgeries were referred to the Radiology Department to evaluate the possibility of the adherent placenta were included. Our study included 66 participants after obtaining written informed consent.

Inclusion criteria: All pregnant females with high clinical suspicion of placenta accreta based on risk factors including previous cesarean sections/uterine surgeries and dilatation and curettage, uterine anomalies, submucous leiomyoma, Asherman's syndrome, advanced maternal age, multiparty, hypertension, and smoking. Pregnant females with previous cesarean sections and ultrasound (USG) diagnoses of placenta previa were included.

Exclusion criteria: The study did not include patients with contraindications to MRI, like having pacemakers, cochlear implants, etc., and claustrophobia and patients who refused to consent.

Our study consisted of 66 pregnant women. Informed written consent was obtained from all participants. Relevant clinical information like parity, number of previous caesarean sections, medical conditions complicating pregnancy and previous uterine surgery were recorded. Participants were evaluated with ultrasonogram with colour Doppler and subsequently with Magnetic Resonance Imaging. Ultrasound and MRI findings were recorded. The patients were followed up till delivery. The placenta was considered normal when the delivery of the placenta was easy without bleeding complications. Diagnosis of placenta accreta was made when the placenta delivery was difficult; when there was a breach of uterine serosa and invasion of adjacent organs, a placenta percreta was made.

Patients were examined supine, and an ultrasonogram with colour doppler was done with GE (General Electric) Ultrasound machine using a 5 MHz curvilinear probe. MRI was done with a 1.5T SEIMENS machine with the patient supine. A phased array coil is placed over the anterior abdominal wall. MRI sequences for placental evaluation are balanced steady-state free precession (true FISP [fast imaging with steady-state precession]) and half-Fourier acquisition single-shot turbo spin-echo (HASTE) T2-weighted sequence. Due to short timing and resistance to motion artifacts, HASTE and True FISP sequences are used. They also provide optimal differentiation between myometrium and placental tissue. T1-weighted GRE (Gradient Echo) sequence helps identify subchorionic haemorrhage, and fat suppression is useful in detecting blood products. The average scan time was around 30 min.

The MRI protocol included examination from the diaphragm to pubic symphysis using: True fast imaging in steady-state precession (TRUFISP; FOV 400 mm; matrix 256 195, 6 mm thick sections), Half-Fourier acquisition single-shot turbo spin echo [HASTE; field of view 400 mm, matrix 256 195, 6 mm thick sections], and T1 weighted images (FOV 220 mm; matrix 256 205; 4 mm thick sections).

The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated for CDUS and MRI. The sensitivity and specificity values of USG and MRI were compared by the McNemar test.

RESULTS

Sixty-six patients with placenta previa underwent ultrasound with colour Doppler and MRI to evaluate placenta accreta. The age group range of patients was 21-37 years, with a mean age of 29. One patient was in primi, and others were multigravida. Of 66 cases, 41 cases had a previous history of caesarean section. A total of 5 (7.6%) had medical illnesses like hypertension and hypothyroidism, complicating pregnancy. There was a previous history of gynaecological surgeries in 12 (18.2%) patients. In total patients, 34 (51.5%) were reported with anterior placental position and 23 (34%) with type 4 placental previa. The mode of delivery was cesarean section in 32 patients (48.5%) and cesarean hysterectomy in 25 (37.9%) [Table 1].

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Table 1: Observation of demographic parameters of patients

Parameters		Observations
Obstetrician score	Multi	65(98.5%)
	Primi	1 (1.5%)
Medical condition	GDM on insulin	1(1.5%)
	HELLP RH isoimmunization	1 (1.5%)
	Hypothyroid	2 (3%)
	Recurrent GHTN	1(1.5%)
	Nil	61 (92.4%)
Gynaecological surgeries	No	54 (81.8%)
	Yes	12 (18.2%)
Placental position	Type 1	16(24%)
	Type 2	17(25%)
	Type 3	10(15%)
	Type 4	23 (34%)
Mode of delivery	Cesarean hysterectomy	25(37.9%)
	Cesarean section	32(48.5%)
	Vaginal delivery with total hysterectomy	1(1.5%)
	Normal	8(12.1%)

Table 2: Observation of different CDUS parameters of patients

Parameters		Observations Frequency (%)
Intraplacental lacunae	No	23 (34.8%)
	Yes	43 (65.2%)
	Sensitivity	80.77%
	Specificity	45%
	PPV	48.84%
	NPV	78.26%
Loss of retroplacental clear space	No	35(53%)
	Yes	31(47%)
	Sensitivity	84.62%
	Specificity	77.5%
	PPV	70.97%
	NPV	88.57%
Uterine bulging	No	33(50%)
	Yes	33 (50%)
	Sensitivity	38.46%
	Specificity	42.5%
	PPV	30.3%
	NPV	51.52%
Disappearance of myometrium	No	37(56.1%)
	Yes	29 (43.9%)
	Sensitivity	61.54%
	Specificity	67.5%
	PPV	55.17%
	NPV	72.97%
Disrupted interface with bladder serosa	No	40
	Yes	26
	Sensitivity	65.38%
	Specificity	77.5%
	PPV	65.38%
	NPV	77.5%
Irregular bladder wall	No	57(86.4%)
	Yes	9 (13.6%)
	Sensitivity	30.77%
	Specificity	97.5%
	PPV	88.89%
	NPV	68.42%
Vascularisation perpendicular to the myometrium	No	55(83.3%)
	Yes	11(16.7%)
	Sensitivity	38.46%
	Specificity	97.5%
	PPV	90.91%
	NPV	70.91%
Bladder wall vascularisation	No	55(83.3%)
	Yes	11(16.7%)
	Sensitivity	38.46%
	Specificity	97.5%
	PPV	90.91%
	NPV	70.91%

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The USG evaluation of patients showed that loss of sub-placental clear space with maximum sensitivity (84.62%), irregular bladder wall, vascularisation perpendicular to the myometrium, and bladder wall vascularisation with maximum specificity, each with 97.5%. PPV was reported highest with vascularisation perpendicular to myometrium and bladder wall vascularisation, each with 90.91%, whereas loss of retroplacental clear space was observed with the highest NVP (88.57%) [Table 2].
The MRI evaluation of all patients revealed the thinning of the myometrium with the highest sensitivity (73.08%), placental heterogeneity with maximum specificity (92.5%) and PPV (76.92%). Whereas NPV was found to be maximum with thinning of the myometrium (80.56%) [Table 3-4].

Table 3: Observation of different MRI parameters of patients

Parameters		Observations Frequency (%)
Placental heterogeneity	No	53(80.3%)
	Yes	13 (19.7%)
	Sensitivity	38.46%
	Specificity	92.5%
	PPV	76.92%
	NPV	69.81%
Presence of T2 dark intraplacental bands	No	36(54.5%)
	Yes	30(45.5%)
	Sensitivity	65.38%
	Specificity	67.5%
	PPV	56.67%
	NPV	75%
Uterine bulge	No	48(72.7%)
	Yes	18 (27.3%)
	Sensitivity	38.46%
	Specificity	80%
	PPV	55.56%
	NPV	66.67%
Thinning of myometrium	No	36(54.5%)
	Yes	30(45.5%)
	Sensitivity	73.08%
	Specificity	72.5%
	PPV	63.33%
	NPV	80.56%
Loss of serosal interface with bladder	No	50(75.8%)
	Yes	16(24.2%)
	Sensitivity	38.46%
	Specificity	85%
	PPV	62.5%
	NPV	68%
Increased sub-placental vascularity	No	40(60.6%)
	Yes	26(39.4%)
	Sensitivity	50%
	Specificity	67.5%
	PPV	50%
	NPV	67.5%

Table 4: Observation of PAS MRI score of patients

			Pathology		Total	P-value
			Normal	Abnormal		
PAS MRI Score	Low risk (Score 0-3)	Count	26	6	32	0.001
		% With PAS MRI Score	81.30%	18.80%	100%	
	Moderate risk (4-5)	Count	10	9	19	
		% With PAS MRI Score	52.60%	47.40%	100%	
	High risk (6-8)	Count	4	11	15	
		% With PAS MRI Score	26.70%	73.30%	100%	
Total		Count	40	26	66	
		% With PAS MRI Score	60.60%	39.40%	100%	

In the present study, USG accurately predicted adherent placenta in 18 of 26 women and correctly ruled out placenta accreta in 32 of 40 patients without placenta accreta. The sensitivity of ultrasound is 69%, and the specificity of ultrasound is 70%. MRI accurately predicted 22 out of 26 cases with PAS and correctly ruled out placenta accreta in 36 out of 40 cases. The sensitivity of MRI is 84%, and the specificity of MRI is 90%.

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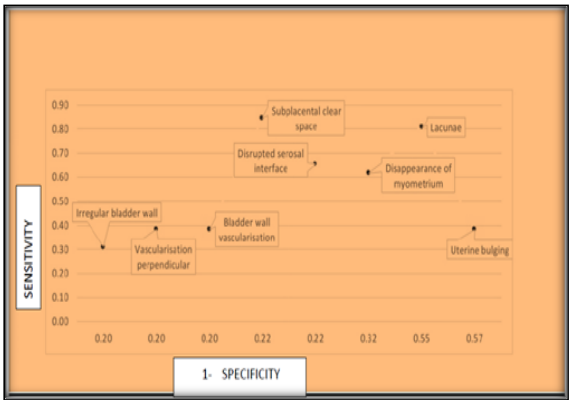


Figure 1: Diagnostics accuracy of USG

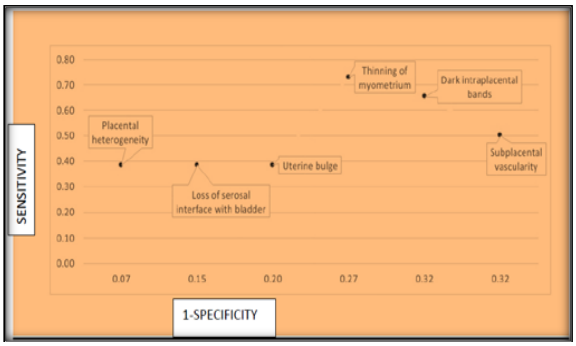
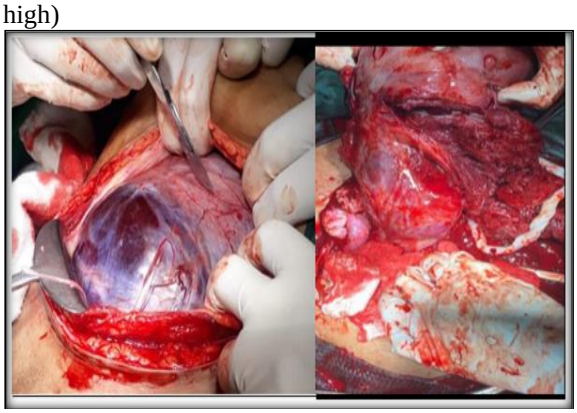


Figure 2: Diagnostics accuracy of MRI

MRI showed placental heterogeneity, dark T2 intraplacental bands, thinning of posterior myometrium, focal bulge, bladder wall vessel sign, lumpy contour and rounded edges, placental tissue within bladder and tenting of bladder (score was 8-high)



Intraoperatively entire lower uterine segment is bulging with bluish placenta with bladder invasion and cesarean hysterectomy and bladder repair done.

DISCUSSION

Sixty-six patients with placenta previa underwent ultrasound with colour Doppler and MRI to evaluate placenta accreta. The age group range of patients was 21-37 years, with a mean age of 29. One patient was in primi, and others were multigravida. Of 66 cases, 41 cases had a previous history of caesarean section. The mode of delivery was Caesarean section in 32 patients (48.5%) and cesarean hysterectomy in 25 (37.9%). Satija et al. also reported similar findings in their investigations.[7]

Total of 5 (7.6%) patients had a medical illness like hypertension and hypothyroidism complicating pregnancy. There was a previous history of gynaecological surgeries in 12 (18.2%) patients. In total patients, 34 (51.5%) were reported with anterior placental position and 23 (34%) with type 4 placenta previa. These findings in the present study follow earlier reported studies.[8]

There has been wide variation in the sensitivity and specificity of ultrasound and MRI in literature, as cited in studies like Lam et al., Peker et al., and Maher et al.[9-11] The sensitivity of USG ranges from 33 to 100% and specificity from 50 to 90% (15-27). The sensitivity of MRI ranges from 38 to 100% and specificity from 55 to 100%.

In our study, the sensitivity of ultrasound in diagnosing adherent placenta is 69%, and the specificity is 70%. The sensitivity of MRI in diagnosing adherent placenta is 84%, and the specificity is 90%.

In our study, USG analysis of patients showed the highest sensitivity for intraplacental lacunae (80.77%) and loss of sub-placental clear space (84.62%) with 45% and 77.5% specificity, respectively. Riteau et al. on USG reported intraplacental cavities and loss of the normal retroplacental clear space with the highest sensitivity (88%) for determination of placental invasion.[12] Warshak et al. reported visualization of cavities with the highest sensitivity in diagnosing placental accreta, with a specificity of 78.6%. Increasing numbers of cavities are associated with increased risk for placental accreta.[13]

In our study, the parameters with high PPV are irregular bladder wall, vascularisation perpendicular to the bladder wall, and bladder wall vascularisation with values of 89%, 90.9% and 90.9%. Riteau et al. reported increased vascularization in the bladder wall, -uterine serosa interface, and vascularization perpendicular to the uterine wall had the best PPV (92%).[12] Comstock et al. showed that the presence of prominent placental lacunae has the highest positive predictive value. In our study, the positive predictive value of intraplacental lacuna is 48.8%.[14]

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Antonio et al. showed that the normal vascularization seen by color Doppler ultrasound has the best sensitivity and specificity and that its localization at the uterus bladder interface has the best specificity in predicting invasive placentation.[15] In our study, vascularisation at the serosal bladder interface had a specificity of 97.5% and a positive predictive value of 90.9%

In our study, loss of retroplacental clear space had a sensitivity of 84.6% and specificity of 77.5%. Intraplacental lacuna had a sensitivity of 80.7% and specificity of 45%, and bladder wall irregularity had a sensitivity of 30% and specificity of 97.5%. Comstock et al. reported that loss of the retroplacental clear space had a sensitivity of 85.2% and specificity of 69.6%. Placental lacunae had a sensitivity of 82% and specificity of 51.3%, and loss of the bladder wall echogenicity had a sensitivity of 41.1% and specificity of 91.8%.[14]

In their study, Mar et al. reported that placental lacunae are the most sensitive marker with the highest positive predictive value (PPV) for placental accreta. However, losing the retroplacental clear space is not an accurate diagnostic marker. Mar et al. also reported high false-positive rates of up to 50%.[16] Overall MRI sensitivity and specificity values for invasive placenta range from 75% to 100% and 65% to 100%. In our study, the sensitivity of MRI is 84%, and the specificity of MRI is 90%.

In our study, reliable features in MRI are placental heterogeneity, abnormal uterine bulging and abnormal T2 dark intraplacental bands. Rahaim et al. showed well-known MRI signs for abnormal placentation—including prominent intraplacental vascularity, myometrial disruption, intraplacental dark T2 bands, and uterine bulge.[17] Bour et al. showed that myometrial thinning or indistinct or interrupted uteroplacental interface was very sensitive but not specific for the discrimination of invasive placenta.[18]

According to Allen et al., uterine serosal hypervascularity and placental bulge are useful MRI features for differentiating percreta and increta from placenta accreta.[19]

Bourgioti et al. showed that the dark intraplacental band had a sensitivity of 60.5%, specificity of 90.9%, positive predictive value of 95.8% negative predictive value of 40.0%. In our study, it has a sensitivity of 65%, specificity of 68%, positive predictive value of 57%, and negative predictive value of 75%.[20]

Prominent intraplacental vascularity had a sensitivity of 94.7%, specificity of 63.6%, positive predictive value of 90.0%, and negative predictive value of 77.8%. Our study had a sensitivity of 50%, specificity of 68%, positive predictive value of 50%, and negative predictive value of 68%.

According to Srisajjakul et al., PAS is unlikely to be seen in a homogeneous placenta. In our study, placental heterogeneity has a specificity of 92% and a positive predictive value of 77%.[21]

CONCLUSION

Our study found MRI more sensitive and specific than ultrasound in detecting adherent placenta. MRI was particularly useful when findings in ultrasound are equivocal for evaluation of the posterior placenta and in the assessment of invasion of adjacent organs in the placenta percreta. Reliable and easily identifiable features in MRI are placental heterogeneity, abnormal uterine bulging, and abnormal T2 dark intraplacental bands. In contrast, reliable and easily identifiable features in CDUS are intraplacental lacuna with turbulent flow and bladder wall irregularity with vascularisation.

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