Original Research Article

Comparison between ultrasound and MRI in antenatal diagnosis of adherent placenta

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ABSTRACT

Background: Placental imaging using ultrasonography and MRI with various parameters provides information about abnormal placentation. Prenatal diagnosis of placenta accreta spectrum disorder (PAS) is of paramount importance to minimize complication rate and improve outcome of delivery. The aim of our study is to compare the accuracy between ultrasound and MRI in antenatal diagnosis of adherent placenta.
Methods: Prospective study was conducted on 50 pregnant women with persistent placenta previa (after 28 weeks of gestation) at Madurai Medical college and Government Rajaji Hospital for period of 18 months. All patients underwent grey scale and doppler USG and MRI. Hemodynamically unstable patients were excluded from the study.
Results: Out of 50 patients of placenta previa, 21 patients were found to have adherent placenta intraoperatively which was subsequently confirmed by HPE. Of this, 16 patients were found to have placenta accreta, 2 patients were found to have placenta increta and 3 patients were found to have placenta percreta. USG predicts possibility of accreta spectrum in 14 out of 21 patients (67% sensitivity). In addition to grey scale ultrasound alone, combined grey scale and colour doppler ultrasound increases sensitivity to 71.4%. MRI predicts possibility of accreta spectrum in 21 out of 21 patients (100% sensitivity). Taking important parameter of retroplacental myometrial thinning in both USG and MRI, specificity approaches 100%.
Conclusions: MRI was a confirming tool for all cases suspected to have placenta accreta spectrum disorders and has higher sensitivity when compared to ultrasonography.

Keywords: Accreta, Increta, Percreta, Previa, MRI, USG

INTRODUCTION

Placental implantation disorders- Placenta accreta (adhesion to myometrium), Placenta increta (Invasion into myometrium), Placenta percreta (Penetration through myometrium) accounts for majority of emergency caesarean hysterectomies.[1] According to literature, antepartum bleeding affects 2-5 percent of pregnancies, with placenta previa accounting for one third of these cases. Several studies have linked placenta previa to risk factors such as advanced maternal age, multiparity, previous caesarean section, previous spontaneous or induced abortion and multiple gestation.[2] Placental imaging using ultrasound including colour doppler and MRI, with various parameters helps in placental localisation and myometrial penetration in patients with placenta previa.[3]

The objective of this study was to make diagnosis of abnormal placental implantation using USG and MRI parameters and thereby to compare the accuracy between USG and MRI in antenatal diagnosis of adherent placenta.

METHODS

The study was prospective study conducted in department of Radio-diagnosis at Madurai medical college and Government Rajaji Hospital, Madurai. The study was

conducted over a period of 18 months (Jan 2020-June 2021). The study was conducted on 50 patients with persistent placenta previa after 28 weeks of gestation. All women underwent ultrasound and non-contrast MRI. Histopathological confirmation was obtained after surgical resection.

Inclusion criteria

The study group included pregnant women who came for routine antenatal ultrasound and found to have persistent placenta previa at or after 28 weeks of gestation and pregnant women with history of previous surgery and uterine instrumentation. Only hemodynamically stable patients were included in the study.

Exclusion criteria

Patients who had contraindications for MRI such as metallic implants, pacemakers etc. and hemodynamically unstable patients were excluded from the study.

Imaging technique and data analysis

All patients underwent transabdominal ultrasound using grey scale and colour/power doppler settings on 2D doppler machine using 4-6MHz curved array transducer. MRI was performed with 1.5 Tesla scanner using pelvic phased array coil. T1(TR/TE 335/15ms), T2(TR/TE 5000/90ms) sequences with FOV 370-400 mm and slice thickness of 5-6mm were obtained. Scanning duration was 30 minutes (Table 1).

Table 1: MRI protocol.

MRI sequences	Non contrast T1 W FSE	MRI T2 W FSE
Imaging plane	Axial and sagittal	Axial and sagittal
TR (m sec)	335	5000
TE (m sec)	15	90
Slice thickness	5mm	5mm

Imaging parameters

Ultrasound parameters include placental position in relation to cervical os, placental thickness whether it is normal or increased, grades of placental lacunae, retroplacental hypoechoic clear space whether it is maintained or not, presence of exophytic mass/placental bulge, irregularity of uterine bladder interface, retroplacental myometrial thickness, placental edge thickness, cervical length

Colour doppler parameters include presence of uterovesical hypervascularity, sub placental hypervascularity, focal gap in retroplacental blood flow, turbulent flow in placental lacunar feeding vessels.[4]

MRI parameters include distance between placental margin and internal cervical os, presence of abnormal uterine bulging, presence of dark T2 intra placental bands, placental signal intensity whether it is homogenous or heterogenous, retroplacental myometrium evaluation (thinning, disruption and trilaminar appearance whether it is maintained or not), fat plane between uterus and adjacent organs.[3,5,6] Some important imaging features of our study cases were depicted in Figures 1-3.
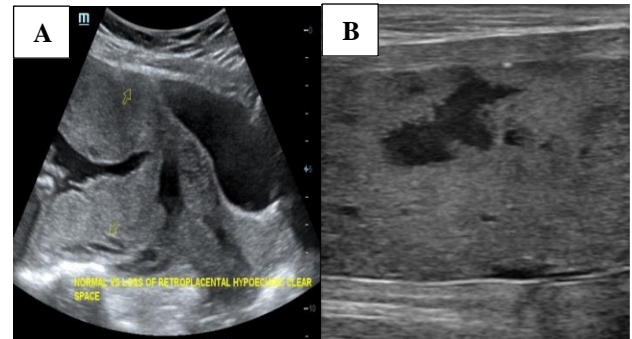

Figure 1: USG features. A) Placenta implanted along the lower uterine segment completely covering the internal os with loss of retro placental hypoechoic clear space along anterior wall (arrow); B) Large intra placental lacuna.
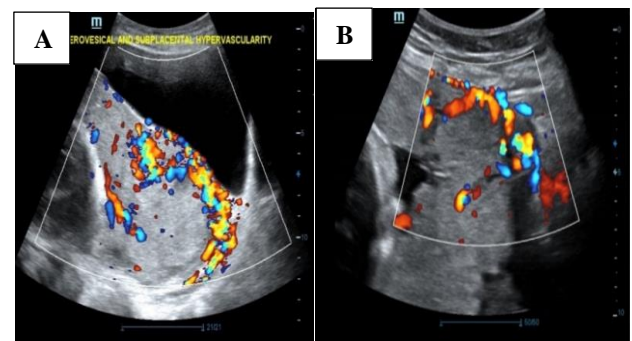

Figure 2: Colour doppler findings. A) Retroplacental uterovesical hypervascularity; B) Large placental lacunar feeding vessel.
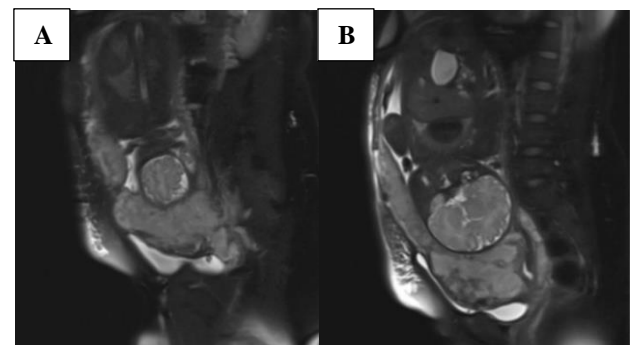

Figure 3: MR imaging findings. A) Abnormal bulging and bumpy contour of placenta; B) Numerous dark T2 intra placental bands.

Statistical analysis

Expressed in terms of sensitivity, specificity, positive predictive and negative predictive value for both ultrasound and MRI.

RESULTS

A total of 50 patients with placenta previa were included in the study. Mean age group of participants were 27.18±5.23 years. Majority of patients in my study group were multigravida and underwent previous LSCS (Table 2).

Table 2: Age, parity and prior instrumentation among study participants.

Characteristics	Frequency	Percentage
Age (in years)		
20-30	45	90
31-35	4	8
>35	1	2
Parity		
Multi	39	78
Primi	11	22
Previous instrumentation		
Previous LSCS	30	60
Previous D&C	6	12
Previous vacuum delivery	1	2

Placenta accreta spectrum

Out of 50 patients of placenta previa, 21 patients (42%) were found to have adherent placenta intraoperatively which was subsequently confirmed by HPE. Of this, 16 patients (32%) were found to have placenta accreta, 2 patients (4%) were found to have placenta increta and 3 patients (6%) were found to have placenta percreta. 18 out of these 21 patients (85.71%) had complete placenta previa subtype and remaining 3 patients had other previa subtypes.
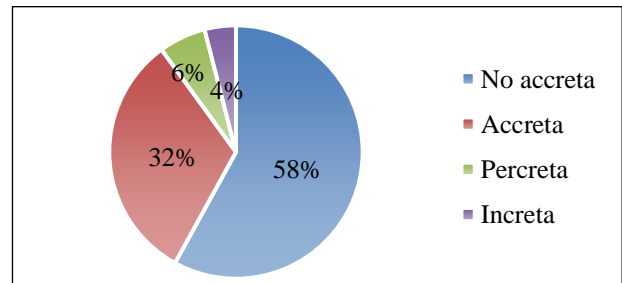

Figure 4: Placenta accreta spectrum among study participants.

Observations in USG evaluation

Out of these 21 patients, who were confirmed to have placenta accreta spectrum intraoperatively and histopathologically, grey scale along with colour doppler ultrasound was correctly able to identify placenta accreta spectrum in 15 patients (71.42%) (Table 3).

Table 3: USG characteristics.

USG characteristics	Frequency	Percentage
Increased placental thickness	7	33.33
Higher placental lacunar grade	14	66.66
Loss of retroplacental hypoechoic clear space	14	66.66
Retroplacental myometrial thinning and disruption	14	66.66
Abnormal bulging contour of placenta	9	42.85
Thick lower placental edge	10	47.61
Uterovesical irregularity	3	14.28
Doppler changes- sub placental hypervascularity, irregular focal gaps in retroplacental blood flow, turbulent flow in lacunar feeding vessels	15	71.42

Table 4: Accuracy of ultrasound in antenatal diagnosis of adherent placenta in patients with placenta previa.

USG (retroplacental myometrium thinning) and Colour Doppler abnormality	HPE (Placenta accreta spectrum)	
	Present	**Absent**
Present	(True positive) 15	(False positive) 0
Absent	(False negative) 6	(True negative) 29
Sensitivity, (%)	71.43 (47.82 to 88.72)	
Specificity, (%)	100 (88.06 to 100)	
Positive predictive value, (%)	100 (95 to 100)	
Negative predictive value, (%)	82.86 (71.08 to 90.48)	
Accuracy, (%)	88.00 (75.69 to 95.47)	

Among USG parameters discussed above in our study taking mainly retroplacental myometrial disruption/thinning into account, USG predicts possibility of accreta spectrum in 14 patients out of 21 patients (67% sensitivity). In addition to grey scale ultrasound alone, combined grey scale and colour doppler ultrasound increases sensitivity to 71.4% (Table 4).

Observations in MRI evaluation

MRI demonstrated disrupted myometrium and loss of normal myometrial signal pattern in all 21 patients confirmed to have placenta accreta spectrum intraoperatively and histopathologically (100% sensitivity). This parameter serves as a significant predictor of placenta accreta spectrum in our study. Based on presence of dark T2 intra placental bands, MRI accurately predicted placenta accreta spectrum in 18 out of 21 patients (86% sensitivity) (Tables 5-7).

Among MRI parameters discussed above in our study taking mainly retroplacental myometrial disruption/thinning and loss of trilaminar appearance into account, MRI predicts possibility of accreta spectrum in 21 out of 21 patients (100% sensitivity).

Table 5: MRI characteristics.

MRI Characteristics	Frequency	Percentage
Thinning and disruption of retroplacental myometrium	21	100
Loss of trilaminar appearance of myometrium	21	100
Presence of dark T2 intra placental bands	18	85.71
Abnormal uterine bulging	13	61.90
Heterogenous placental signal intensity	13	61.90
Loss of fat plane between uterus and adjacent organs	5	23.80

Table 6: Accuracy of MRI in antenatal diagnosis of adherent placenta in patients with placenta previa based on presence of dark T2 intra placental bands.

MRI (Dark T2 intra placental bands)	HPE (Placenta accreta spectrum)	
	Present	**Absent**
Present	(True positive) 18	(False positive) 0
Absent	(False negative) 3	(True negative) 29
Sensitivity, (%)	85.71 (63.66 to 96.95)	
Specificity, (%)	100 (88.06 to 100)	
Positive predictive value, (%)	100	
Negative predictive value, (%)	90.62 (77.22 to 96.50)	
Accuracy, (%)	94.00 (83.45 to 98.75)	

Table 7: Accuracy of MRI in antenatal diagnosis of adherent placenta in patients with placenta previa based on presence of thinning and disruption with loss of trilaminar appearance of myometrium.

MRI (Thinning and disruption with loss of trilaminar appearance of retroplacental myometrium)	HPE (Placenta accreta spectrum)	
	Present	**Absent**
Present	(True positive) 21	(False positive) 0
Absent	(False negative) 0	(True negative) 29
Sensitivity, (%)	100 (83.89 to 100)	
Specificity, (%)	100 (88.06 to 100)	
Positive predictive value, (%)	100	
Negative predictive value, (%)	100 (77.22 to 96.50)	
Accuracy, (%)	100 (86.29 to 99.51)	

DISCUSSION

This study was conducted to compare the accuracy of ultrasound and MRI in prenatal diagnosis of placenta accreta spectrum disorders.

D'Antonio et al, demonstrated that ultrasound had sensitivity of 85.7%, Meng et al, demonstrated that ultrasound had sensitivity of 83% and Japaraj et al, found that ultrasound had sensitivity of 85%.[7-9] In this study, we found that ultrasonography had sensitivity of 71 percent in diagnosing placenta accreta spectrum disorders. The

difference in sensitivity of USG between studies is due to the fact that transvaginal ultrasound was used in their studies but not used for all patients in this study.

In this study, statistical difference in sensitivity was identified between USG and MRI but no difference in specificity between the two methods. Only patients who were suspected of having adherent placenta were referred for MRI, raising the specificity of the scan while decreasing the sensitivity of the scan.

According to study conducted by Riteau et al, there is no significant difference between the two modalities in diagnosing improper placental attachment to myometrium.[10] This study also showed that both USG (88%) and MRI (94-100%) are highly and equally accurate in diagnosis of placental invasion.

Ultrasonography is affordable and time saving for diagnosis of placenta accreta and MRI is an adjunct to ultrasound and it can reveal certain unique imaging features which are helpful in agreeing or denying the final diagnosis.

In this study, most common ultrasound feature in predicting placenta accreta was retroplacental myometrial thinning and disruption. Cut off for myometrial thickness is 1mm.[11] According to Twickler et al, presence of myometrial thinning was most important ultrasound parameter in predicting invasion which concurs with our study.[12] Both retroplacental hypoechoic clear space and retroplacental myometrial thinning has higher chances of false positive rates, but in our study, there is no false positivity. The chances for false negativity in our study is due to spurious shadows misinterpreted as retroplacental clear space and difficulty in assessment of lower uterine segment myometrial thickness in term patients.

Higher placental lacunar grade correlates with placenta accreta spectrum.[13] Even though it is not pathognomonic feature, many authors consider the presence of intra placental lacunae to be best ultrasonography feature similar to our study.[14-16] Increased placental thickness is not a reliable criterion and it is non-specific affected by many conditions such as congenital infections, anaemia, IUGR and diabetes and even in adherent placenta thickness can be normal as in our study.[17] Thick lower placental edge (>1cm) was also difficult to be assessed in our study because of inability to perform transvaginal ultrasound in many patients due to risk of bleeding.

All 3 patients of placenta percreta in our study had USG finding of uterovesical irregularity which is a most specific ultrasound marker of invasive placentation.[7]

According to Lerner et al, colour doppler findings improve the accuracy of diagnosis when added to grey scale ultrasound.[18] Our study agreed with the same. Addition of colour doppler increased the sensitivity to 71%.

In this study, addition of MR imaging to ultrasound increases the sensitivity to 100%. In our study MR imaging serves as an excellent tool for detection of myometrial invasion and helps in optimal surgical management. MRI results in our study concurs with D'Antonio et al, Varghese et al, Lax et al, which depends on myometrial wall interruptions, dark T2 intra placental bands, placental heterogeneity and uteroplacental bulging.[7,19,20] In this study we found that myometrial interruption was seen in 100%, dark T2 intra placental bands was seen in 86% and abnormal bulging and heterogeneity in 62% cases.

Abnormal uterine bulging can be absent and placenta can be homogenous even in patients with invasive placenta thus accounting for false negativity in this study.

MRI demonstrated loss of fat plane between uterus and adjacent organs in 5 patients in our study. Of this, 3 patients had placenta percreta and 2 patients had placenta increta intraoperatively and HPE confirms the diagnosis. This parameter again serves as an accurate predictor of invasive placentation.[21]

No false positive diagnosis in our study.29 out of 50 patients in our study were negative for accreta both radiologically and surgically. So with the help of important parameters in USG and MRI specificity approaches 100%. These are some strength of our study.

This study has few limitations. Our sample size is small. We evaluated USG and MRI parameters in 50 patients of placenta previa only. Since the LSCS is on the rising trend nowadays, incidence and prevalence of placenta previa among pregnant women is also rising and in future we may need a higher sample size to strengthen our results further. Ultrasound fails to correctly identify accreta in obese patients due to poor resolution. For these patients MRI is a must to diagnose or rule out accreta spectrum. If patient presents with severe bleeding or suddenly became hemodynamically unstable, MRI examination could not be done to confirm ultrasound findings. Luckily in our study, all patients were hemodynamically stable and hence we performed MRI for all patients.

CONCLUSION

In our study we found that MRI was a confirming tool for all cases suspected to have placenta accreta by ultrasound and has greater sensitivity than USG in predicting placenta accreta spectrum whereas both USG and MRI are specific with comparable accuracy between the two. Timely prenatal diagnosis of placenta accreta spectrum disorders helps in minimizing complication rate and improves the outcome of delivery.

ACKNOWLEDGEMENTS

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