Original Article

Accuracy of Magnetic Resonance Imaging in Diagnosing Morbidly Adherent Placenta

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Abstract

Objectives: To determine the accuracy of magnetic resonance imaging (MRI) in diagnosing morbidly adherent placenta, taking surgical findings as the gold standard.

Methods: In this cross-sectional descriptive study, a total of 107 patients with the suspected morbidly adherent placenta (MAP) and ages between 20-40 years underwent MRI pelvis. Images were assessed by an experienced radiologist for the presence or absence of morbidly adherent placenta (MAP). All patients later had surgery and operative findings were compared with MRI findings. Data was analyzed by IBM SPSS Statistics for Windows, version 21.0. Armonk, NY.

Results: The age range of the patients was from 20-40 years with a mean age of 28.31 ± 3.86 years. Most of the patients 87 (81.31%) were between ages 20 to 30 years. In 60 MRI positive cases, 53 were true positive and the other 07 were false positive. In 47 MRI negative patients, 40 were true negative and 07 were false negative. Overall sensitivity, specificity, and diagnostic accuracy of MRI in diagnosing MAP, taking operative findings as the gold standard was 88.33%, 85.11%, and 86.92% respectively.

Conclusion: Magnetic resonance imaging (MRI) is an excellent modality with a highly sensitive and accurate modality for diagnosing morbidly adherent placenta (MAP).

Key Words: Morbidly adherent placenta(MAP), Magnetic resonance imaging(MRI)

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Introduction

The placenta is important for the survival of the fetus as it is responsible for its respiratory function, nourishment, and excretion during antenatal life. The morbidly adherent placenta is abnormal placentation into the uterine wall or beyond is a potential risk to fetal and maternal health and life therefore it is of utmost importance to identify such cases as early as possible[1]. In these cases the placenta fails to be delivered safely which in turn can cause hemorrhage (PPH) and damage to the adjacent structures like the urinary bladder and ureters if adheres to them[2]. These patients usually end up in emergency hysterectomy which counts for 30% -50% of all postpartum hysterectomies in emergency.[3,5,6] Early and accurate diagnosis is therefore critical so that the patient can be counselled in time. For diagnosis of MAP grey scale and doppler ultrasound is usually considered as the initial imaging investigation due to its easy accessibility along with high sensitivity and specificity counting as high as 77-90% and 70-96% respectively for placenta accreta[6]. Placenta previa with placental lacunae, myometrial thinning and absence of the retroplacental clear zone are grey scale features of placenta accreta while doppler

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study shows abnormal color mapping and pattern. In the placenta percreta additional finding of abnormally irregular wall of the urinary bladder is noted. [2, 6]

As early and accurate diagnosis of MAP by imaging modalities allows timely and effective management which helps to minimize mortality and reducing morbidity.[4] MRI is generally used as an adjunct to the US in diagnosing MAP where clinical suspicion is high but ultrasound findings are equivocal.[6] Einerson BD et al[7] has shown the prevalence of MAP as 52.0% and the sensitivity and specificity of MRI in diagnosing MAP as 77.30% and 75.0% respectively. Another study has shown the sensitivity and specificity of MRI in diagnosing MAP as 100.0% and 21.1%.[8] Othman AIA et al has shown similar results.[9] While a local study also claims accuracy of the MRI in detecting MAP to be 71.4%.[10] Another study shows the sensitivity and specificity of MRI in diagnosing MAP as 100.0% and 76.9%.[11]

Methodology

It is a descriptive analytical study conducted in Radiology Department of a public sector tertiary care hospital of Rawalpindi over a period of one year from 31st May 2019 to 30th May 2020. Using non-probability consecutive sampling, a total of 107 cases were included in the study.

Inclusion Criteria:

- Patients with suspected MAP having GA ≥37 weeks (assessed by LMP).
- Age 20-40 years.
- Parity 2-6.(H/O previous C section deliveries in increasing order)

Exclusion Criteria:

- Patients with h/o antepartum hemorrhage (assessed on clinical examination).
- Patients who have a contraindication to magnetic resonance imaging i.e. MRI incompatible cardiac pacemaker, prosthesis or claustrophobic.

After approval from institutional ethical review committee, 107 patients presenting to Radiology department of Holy Family Hospital, Rawalpindi, fulfilling the inclusion criteria underwent pelvic MRI. Prior informed consent was taken from each patient. MRI pelvis was done using 1.5 Tesla MRI GE machine. Fast spin echo (FSE) axial T1WI and axial coronal and sagittal T2WI images of the pelvis was obtained followed and fat-suppressed post contrast T1WIsagittal, coronal and axial images of pelvis. Images were interpreted by a senior radiologist (having at least 3 years of post-fellowship experience) and results were noted by the researcher. All study patients later had surgery and operative findings were noted. MRI findings were compared with operative findings.

Data was analyzed by IBM SPSS Statistics for Windows, version 21.0. Armonk, NY. Standard deviation were calculated for age, gestational age and parity. Frequency and percentage were calculated for the presence or absence of MAP on MRI and operative findings. A 2×2 contingency tables was employed to indicate sensitivity, specificity, positive predictive value(PPV), negative predictive value(NPV) and diagnostic accuracy of MRI in diagnosing MAP. In addition, stratification was performed for age, gestational age and parity. Post-stratification diagnostic accuracy was also calculated.

- Sensitivity (Using Equation-1)
- Specificity (Using Equation-2)
- Positive predictive value (Using Equation-3)
- Negative predictive value (Using Equation-4)
- Overall Accuracy (Using Equation-5) = 84.2%

Equation-1 = Sensitivity's Formula

$$\text{Sensitivity} = \frac{\text{True-Positive}}{\text{True-Positives (+) False-Negatives}} \times 100$$

Equation-2 = Specificity's Formula

$$\text{Specificity} = \frac{\text{True-Negative}}{\text{True-Negatives (+) False-Positives}} \times 100$$

Equation-3 = Positive Predictive Values Formula

$$\text{PPV} = \frac{\text{True-Positive}}{\text{True- Positives (+) False-Positives}} \times 100$$

Equation-4 = Negative Predictive Values Formula

$$\text{NPV} = \frac{\text{True-Negative}}{\text{False-Negatives (+)True-Negatives}} \times 100$$

Equation-5 = Diagnostic Accuracy's Formula

$$\text{Accuracy} = \frac{\textbf{True-Positives (+) True-Negatives}}{\textbf{True-Positives (+) True-Negatives (+) False-Positives (+) False-Negatives}} \times 100$$

MAP on MRI		MAP on operation	
		Yes	No
	Yes	**True Positive (a)**	**False Positive (b)**
	No	**False Negative (c)**	**True negative (d)**

Results

The age range of the patients was from 20-40 years with a mean age of 28.31 ± 3.86 years. Most of the patients 87 (81.31%) were between ages 20 to 30 years (Table I). The mean gestational age was calculated as 38.60 ± 1.28 weeks while mean parity came out to be 2.32 ± 1.36 (Table II).

MRI showed MAP in 60 (56.07%) patients. Operative findings confirmed it in 60 (56.07%) cases whereas 47 (43.93%) patients had no evidence of MAP. Among the patients with positive MRI, 53 were true positive whereas 07 were false positive. Patients negative for MAP on MRI were 4, among which 07 were false negative while 40 were true negative(Table III)

The sensitivity and specificity of MRI, therefore, was 88.33% and 85.11% respectively. PPV, NPV and diagnostic accuracy of MRI in diagnosing MAP, taking operative findings as the gold standard was 88.33%, 85.11%, and 86.92% respectively.

Diagnostic accuracy in different parous groups is shown in Tables IV & V.

Table-I: Distribution of patients according to Age.

Age (years)	No. of Patients	%age
18-28	87	81.31
29-38	20	18.69
Total	107	100.0

Mean ± SD = 28.31 ± 3.86 years

Table-II: Distribution of patients according to parity (n=107).

Parity	Frequency	%age
2-3	76	71.03
4-6	31	28.97

Mean ± SD = 2.32 ± 1.36

Table-III: Diagnostic accuracy of MRI in diagnosing MAP, taking operative findings as gold standard.

		MAP on operative findings		P-value
		present	absent	
MAP on MRI	present	53	07	0.0001
	absent	07	40	

Sensitivity: 88.33%, **Specificity:** 85.11%
PPV: 88.33%, **NPV:** 85.11%
Diagnostic Accuracy: 86.92%

Table IV: Diagnostic accuracy with respect to parity 2-3 (n=76).

	Positive result on operative findings	Negative result on operative findings	P-value
Positive result on MRI	35 (TP)	07 (FP)	**0.001**
Negative result on MRI	07 (FN)	27 (TN)	

Sensitivity: 83.33%, **Specificity:** 79.41%
PPV: 83.33%, **NPV:** 79.41%
Diagnostic Accuracy: 81.58%

Table V: Diagnostic accuracy with respect to parity 4-6 (n=31).

	Positive result on operative findings	Negative result on operative findings	P-value
Positive result on MRI	18 (TP)	00 (FP)	**0.001**
Negative result on MRI	00 (FN)	13 (TN)	

Sensitivity: 100.0%, **Specificity:** 100.0%
PPV: 100.0%, **NPV:** 100.0%
DiagnosticAccuracy:100.0%

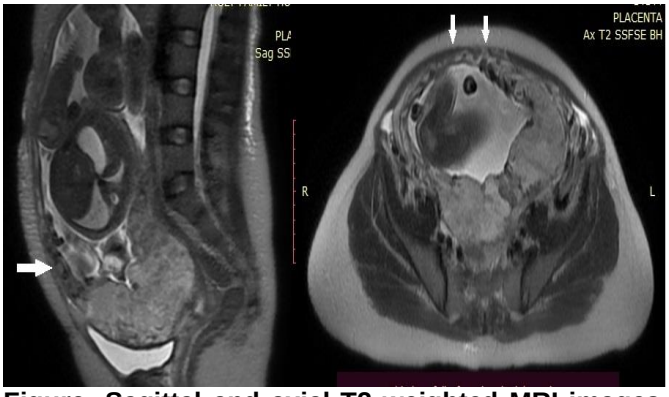

Figure: Sagittal and axial T2 weighted MRI images showing grade IV placenta previa and focal disruption of myometrium with low intensity placental band extending into myometrium (white arrows)

Discussion

Early diagnosis and a multidisciplinary team approach has high chances of reducing maternal and fetal complications mortality and morbidity in cases of MAP. In addition complications like intrapartum hemorrhage, blood transfusion requirement, intraoperative gastrointestinal and urological injuries can be significantly recuced.[12,13] Ultrasound has a vital role in antenatal evaluation secondary to its ready availability and noninvasive nature and sensitivity and specificity; it is considered as first line imaging investigation in cases of MAP.[14] Accuracy of ultrasound examination depends on the expertise of the operator. In addition, it may sometimes be difficult to examine the entire placenta especially the posterior and distal portions. MRI acts as a problem solving modality in such situations by identifying specific diagnostic signs.[14,15]

The normal placenta exhibits uniform thickness which varies from 2 to 4 cm in the mid region and has a regular well defined and smooth external border and margins tapering towards the edges.

Normal placenta has regular lobules also known as cotyledons on its maternal side. Invasion may be manifested as a bulge on the uterine margin, placental low signal bands, heterogeneity of placenta, and interruptions in the hypointense myometrial border.[22]

Our study shows an overall MR diagnostic accuracy of 86.92% with sensitivity and specificity of 88.33% and 85.11% respectively. These results are comparable to other studies.[16,17,18,19] Einerson BD et al[7] has shown the prevalence of MAP as 52.0% and the sensitivity and specificity of MRI in diagnosing MAP as 77.30% and 75.0% respectively. Another study has shown the sensitivity and specificity of MRI in diagnosing MAP as 100.0% and 21.1%.[8]

Another analysis shows 57.7%–90.8% sensitivity and 50.4%–98.0% specificity for heterogeneous signals in the placental parenchyma which are related to intraparenchymal hemorrhage and lacunae.[16] However according to Lax et al[17] this signal can be seen in both normal and morbidly adherent placentas. It therefore should be noted that only marked heterogeneity should be related to the invasion.[17]

These studies showed high accuracy of US and MRI in the diagnosis of MAP. US plays an important role in diagnosing placenta accreta, sonographic features suggesting placenta accrete are placental lacunae which has the highest sensitivity of 93%.[20,21] Color flow Doppler is the standard in diagnosing placenta accreta however MRI is vital to evaluate the degree and depth of invasion i.e. differentiate placenta accreta, increta and percreta. Othman AIA et al has shown the sensitivity and specificity of MRI in diagnosing MAP as 100.0% and 85.7% respectively.[9] while a local study has shown the sensitivity, specificity and accuracy of the MRI in diagnosing MAP as 71.4%, 72.2%, and 72% respectively.[10]

Conclusion

MRI is a highly accurate modality for diagnosing MAP and has its role in improving ability to diagnose MAP but also in improving patients. Being accurate and non-invasive investigation, we recommend it as a primary screening tool where available, for accurate identification of MAP.

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