

Role of MRI in diagnosis of placenta accreta.

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Abstract: Objective: The purpose of this article is to describe the MRI technique, features of placenta accreta in MRI and role of MRI in diagnosis of placenta accreta. **Materials and Methods:** Thirteen patients were referred to MRI unit with suspected placenta accreta by transabdominal ultrasound or showed inconclusive findings. MRI was done and the MRI diagnosis was compared to post partum findings and histopathological assessment. **Results:** MRI diagnosed placenta accreta in 8 cases, from total 13 patients (confirmed after delivery by pathological examination). 4 cases were negative by MRI. In two of the negative cases placentas were easily manually removed during cesarean delivery without any bleeding or complications, while at the rest two cases placenta accreta was diagnosed after the manual removal of the placenta and hysterectomy was done at one case owing to uncontrollable bleed. One case was interpreted as placenta accreta on MRI and was negative during cesarean delivery. MRI shows sensitivity and specificity of 83.33 % & 66.67 % respectively. **Conclusions:** MRI as a complementary technique can help in diagnosis of placenta accreta by additional information in ultrasound doubtful cases.

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Key words: Magnetic resonance imaging, placenta, placenta accreta, prenatal diagnosis.

Abbreviations: NPV: negative predictive value, MRI: magnetic resonance imaging, PPV: positive predictive value, PA: Placenta accreta, C.S: Cesarean section, USG: Ultrasonography

1. Introduction:

Major risk factors for PA are placenta previa and prior uterine surgery, including cesarean delivery (**Garmi et al 2012**).

The prevalence of placenta accreta has increased more than 10-fold in the past 30 years to approximately 1 in 2500 deliveries (**Warshak et al 2006**). This increase appears to relate to the increasing rate of uterine surgery (curettage or cesarean delivery), which results in a decidual defect that allows abnormal placental ingrowth (**Hill et al 1983**).

The combination of placenta previa and prior instrumentation has been identified as a significant synergistic combination for the development of placenta accreta, with rates as high as 50%–67% (**Warshak et al 2006**). Other risk factor is increasing maternal age (**Derman et al 2011**).

Complications of placenta accreta include massive hemorrhage, damage to the uterus, bladder, ureters, and bowel, and often cesarean hysterectomy to control bleeding. Optimal management requires accurate prenatal diagnosis.

Ultrasonography (USG) and magnetic resonance imaging (MRI) are the modalities for prenatal diagnosis of PA, although USG remains the primary investigation of choice (As it is relatively inexpensive and easily available). MRI as a

complementary technique can provide additional information in doubtful cases.

The purpose of this article is to describe the MRI technique and features of placenta accreta in MRI.

2. Materials and methods:

2.1. Patients:

From March 2013 to February 2014, thirteen patients (gestational age ranged from 31 – 39 weeks gestation) were referred to MRI unit with suspected placenta accreta by transabdominal ultrasound or showed inconclusive findings. Their average age was 30.38 years (range 20 to 39), All have history of previous cesarean deliveries (10 cases with multiple C.S) with or without concomitant placenta previa (placenta previa was detected in 3 cases), and had the initial sonographic evaluation of the placenta during a routine prenatal examination.

The indications for MR evaluation of the placenta in patients are placenta previa with doubtful sonographic features of placenta accreta, posterior location of the placenta with lack of adequate visualization, multiple previous cesarean deliveries especially with anterior placenta and anterior placenta with poor visualization of the region of the cesarean scar on sonography. The findings were compared to post partum findings and histopathological assessment.

Written informed consent was abstained from each patient and the local ethical committee has approved the study.

2.2. Technique:

MRI was performed with a 1.5-T whole-body MRI scanner (GE Healthcare signa). T2-weighted half-Fourier RARE sequence (HASTE or half-Fourier single-shot fast spin-echo) acquired in the axial, sagittal, and coronal planes is the key technique employed for evaluation of placenta. TR/TE of 2000/67 and flip angle of 180° and a T2 true fast imaging with steady-state precession (FISP) sequence with a TR/TE of 4.3/2.15 and flip angle of 77°. An FOV of 325–425 cm and 4-mm cuts were used.

Balanced steady-state free precession (True FISP) sequence in three orthogonal planes and T1-weighted gradient-echo sequence TR/TE of 165/2.5 milliseconds, a flip angle of 90°, a 384 × 192 data matrix, and a slice thickness of 5 mm. The field of view was usually 38 cm. HASTE and True FISP sequences are relatively resistant to maternal and fetal motion artifacts and provide reasonable differentiation between the placental tissue and underlying myometrium. T1-weighted gradient-echo sequence is useful in visualizing any high-signal-intensity subchorionic hemorrhage, and use of fat suppression in conjunction improves the conspicuity of blood products.

The exam was done in supine or left lateral decubitus position depending on patient tolerability. Urinary bladder during scan was asked to be moderately distended.

2.3. Imaging:

MR imaging features considered diagnostic of placenta accreta include abnormal uterine bulging, heterogeneous placental signal intensity on T2-weighted images, and the presence of dark intraplacental bands related to lacunae on T2-weighted images (**Baughman et al 2008**). Focal interruptions of the myometrial wall (high specificity for increta and percreta) and Tenting of urinary bladder (highly specific for percreta) (**Binoj Varghese et al 2013**). Dark intraplacental bands appear as nodular or linear areas of low signal intensity on T2-weighted images (HASTE and True FISP) and typically extend within the placenta from the placenta-myometrium interface. These bands are thicker than the normally fine placental septa and show a random distribution. They represent areas of fibrin deposition within the placenta.

Abnormal disorganized placental vascularity is described as hypertrophied, tortuous disorganized vessels deep within the placenta, located in some of the areas of dark bands. These areas of signal void on

T2 HASTE images show hyperintensity on flow-sensitive True FISP images.

Heterogeneous signal intensity in the placenta depends primarily on the presence or absence of abnormal T2 dark bands. It may also represent areas of hemorrhage in the placenta or increased vascularity. Homogeneous placenta can exclude abnormal placentation with high levels of confidence.

A focal outward contour bulge or disruption of the normal pear shape of the uterus, with the lower uterine segment being wider than the fundus, can be seen in PA. Focal interruptions of the myometrial wall or extension through the myometrium with occasional invasion of adjacent structures can also be seen. Placenta directly invading or tenting the urinary bladder is highly specific for placenta percreta. MRI is particularly useful in showing parametrial extension which is not apparent on USG.

Focal thinning and indistinctness of the myometrium and loss of thin T2 dark uteroplacental interface are unreliable signs of PA. MRI is less reliable in differentiating between different degrees of placental invasion, especially between accreta vera and increta (**Binoj Varghese et al 2013**).

We use the term “accreta” as an umbrella term for invasive placentation.

2.4. Statistics

The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated and compared by the McNemar test.

3. Results:

A total number of 13 patients who were clinically at high risk for placenta accreta, underwent prenatal MRI due to inconclusive sonography at gestational age ranged from 31 – 39 weeks gestation 10 cases had history of multiple C.S (about 76.9 %), 3 cases (about 23%) with single previous C.S. and three cases of total 13 (about 23%) had placenta previa.

MRI diagnosed placenta accreta in 8 cases, from total 13 patients (confirmed after delivery by pathological examination). 4 cases were negative by MRI. In two of the negative cases placentas were easily manually removed during cesarean delivery without any bleeding or complications, while at the rest two cases placenta accreta was diagnosed after the manual removal of the placenta and hysterectomy was done at one case owing to uncontrollable bleed. One case was interpreted as placenta accreta on MRI and was negative during cesarean delivery.

In MRI We use the term “accreta” as an umbrella term for invasive placentation.

Of the 8 true positive cases, 5 patients were pathologically proven placenta accreta, two patients were pathologically proven placenta increta, and one patient were pathologically proven placenta percreta with focal invasion of the urinary bladder. two of these patients also had placenta previa. [Figures 1,2]

We diagnosed one case as placenta percreta with focal invasion of the urinary bladder wall that was proved by histopathology [Figure 3].

One case has placenta previa with no evidence of placenta accreta on MRI examination and placenta was easily manually removed during cesarean delivery without any bleeding [Figure 4]. In 4 cases, the placenta was anterior and overlying the cesarean scar, in 3 cases placenta previa was seen, in 3 cases posterior location of the placenta and in 3 cases were lateral location of the placenta was identified.

MRI shows Sensitivity, Specificity of 83.33 % and 66.67 % respectively. [table 1]

For the diagnosis of placenta accreta on MRI, the following criteria were used in the study:

Significantly heterogeneous placenta, Focal thinning and indistinctness of the myometrium and loss of the retroplacental T2 dark zone, intraplacental dark bands on T2-weighted HASTE and T2-weighted true FISP images, and disorganized abnormal placental vascularity, focal interruptions of the myometrial wall or direct extension of placental tissue through the myometrium and abnormal venous lakes seen as tortuous enlarged flow voids on the T2 HASTE sequence deep within the placenta that showed high signal on the true FISP sequence. [table 2]

Table 1 Sensitivity, Specificity, PPV, and NPV of MRI

Sensitivity	Specificity	PPV	NPV
83.33 %	66.67 %	90.91 %	50.00 %

Table 2: Summary for patients, MRI findings correlated with histopathological findings and description of findings:

Case no	age	No of C.S	Placental location	MRI findings	Histopathological diagnosis	Description of findings
1	35	2	posterior	Dark T2 bands on maternal side of placenta, severe heterogeneous texture of the placenta	Placenta accreta	True positive
2	37	3	Anterior	Dark T2 bands on maternal side of placenta, severe heterogeneous texture of the placenta, focal thinning and indistinctness of the myometrium and loss of the retroplacental T2 dark zone and focal infiltration of urinary bladder wall.	Placenta percreta	True positive
3	20	1	Lateral	Homogenous placenta, clear retroplacental zone.		True negative
4	22	2	anterior	Mild heterogeneous placenta	Placenta accreta	False negative
5	27	2	lateral	Moderate heterogeneous texture of the placenta, dark T2 bands on maternal side of placenta	Placenta accreta	True positive
6	39	3	Placenta previa	Moderate heterogeneous texture of the placenta, dark T2 bands on maternal side of placenta	Placenta accreta	True positive
7	31	1	Placenta previa	Homogenous placenta, clear retroplacental zone.		True negative
8	28	1	posterior	Dark T2 bands on maternal side of placenta, Moderate heterogeneous texture of the placenta	Placenta accreta	True positive
9	31	3	anterior	Low signal areas interpreted as dark T2 bands.	Mature placenta with intraplacental infarction	False positive
10	32	2	posterior	Mild heterogeneous placenta	Placenta accreta	False negative
11	26	2	Lateral	Dark T2 bands on maternal side of placenta, Mild heterogeneous texture of the placenta and focal thinning and indistinctness of the myometrium and loss of the retroplacental T2 dark zone	Placenta accreta	True positive
12	34	3	Placenta previa	Dark T2 bands on maternal side of placenta, focal thinning and indistinctness of the myometrium and loss of the retroplacental T2 dark zone	Placenta accreta	True positive
13	33	2	anterior	Dark T2 bands on maternal side of placenta, Moderate heterogeneous texture of the placenta	Placenta accreta	True positive

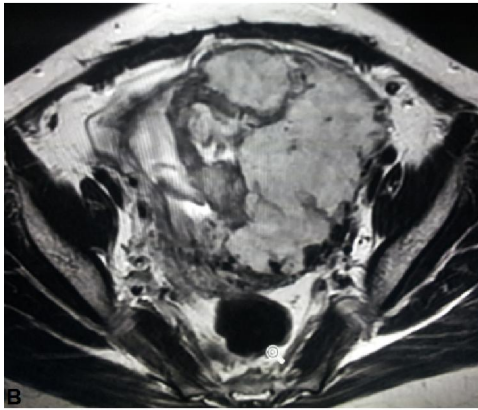
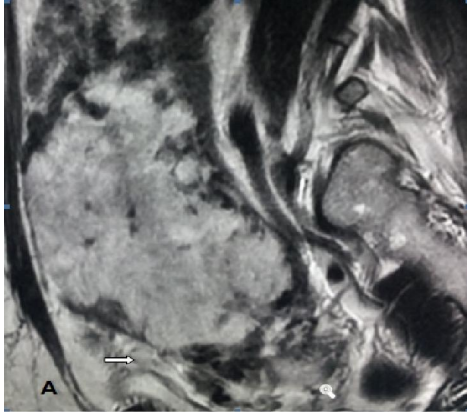


Figure 1: 26 years patient with 33 weeks gestation, previous 2 lower segment C.S.
Sagittal A and axial B T2 HASTE MR images show Dark T2 bands on maternal side of placenta, heterogeneous texture of the placenta, focal thinning and indistinctness of the myometrium at lower aspect of the uterus (arrow).

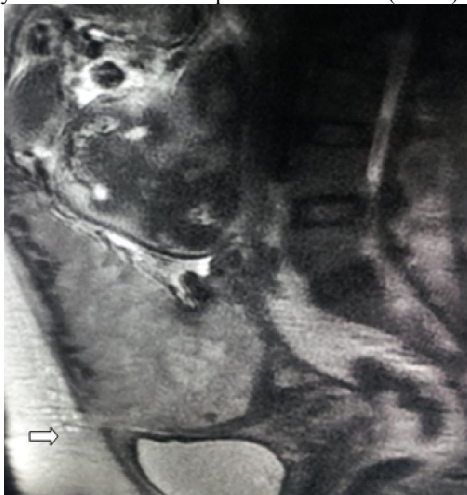


Figure 2: 34 years patient with 31 weeks gestation, previous 3 lower segment C.S.
Sagittal T2 HASTE MR image shows Dark T2 bands on maternal side of placenta, focal thinning and indistinctness of the myometrium and loss of the retroplacental T2 dark zone at anterior aspect of lower uterine segment (site of previous scar) (arrow).

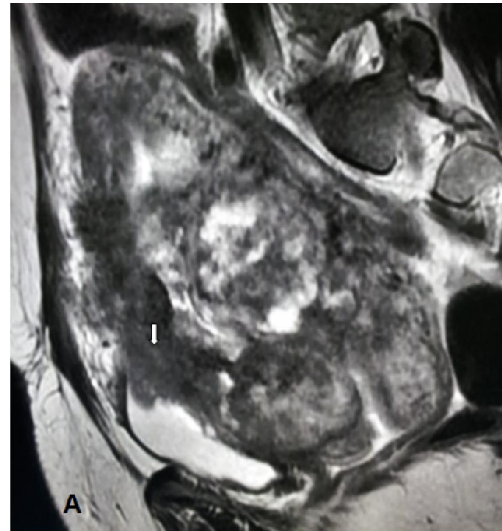


Figure 3: 37 years patient with 33 weeks gestation, previous 3 lower segment C.S. Left anterolateral placenta.
Sagittal A and coronal B T2 HASTE MR images show Dark T2 bands on maternal side of placenta, severe heterogeneous texture of the placenta, focal thinning and indistinctness of the myometrium and loss of the retroplacental T2 dark zone and focal infiltration of urinary bladder wall (arrows).



Figure 4: 31 years patient with 32 weeks gestation, previous lower segment C.S.

Coronal A and Sagittal B T2 HASTE MR images show placenta previa with normal homogenous texture of the placenta, clear retroplacental zone and no evidence of myometrial invasion.

4. Discussion:

Placenta accreta is a severe pregnancy complication and life-threatening condition whose incidence has been rising steadily over the past 50 years.

Major risk factors for PA are placenta previa and prior uterine surgery, including cesarean delivery (**Garmi et al 2012**). The combination of placenta previa and prior instrumentation has been identified as a significant synergistic combination for the development of placenta accreta, with rates as high as 50%–67% (**Warshak et al 2006**). Other risk factor is increasing maternal age (**Derman et al 2011**).

Accurate prenatal diagnosis is the most important factor affecting outcome, as under

diagnosing or over diagnosing PA can create major problems.

Ultrasonography (USG) and magnetic resonance imaging (MRI) are the modalities for prenatal diagnosis of PA, although USG remains the primary investigation of choice (As it is relatively inexpensive and easily available). MRI as a complementary technique can provide additional information in doubtful cases (as in patients showing placenta previa with doubtful sonographic features of placenta accreta, posterior location of the placenta with lack of adequate visualization, multiple previous cesarean deliveries especially with anterior placenta and anterior placenta with poor visualization of the region of the cesarean scar on sonography).

In our study two false negative patients at the study with surgically and histologically proven placenta accreta, on MRI examination the false-negative results were due to less heterogeneity of the placenta and, low-signal-intensity bands were small and were not distinctly seen in all planes also partial empty urinary bladder during scan limits the interpretation.

One false positive patient, MRI showed low signal area interpreted as dark T2 bands and on histopathological findings revealed placental infarction without accreta, **Binoj Varghese et al 2013** has said that the dark intraplacental bands are also seen in placental infarction and intervillous thrombus and described this as a common pitfall in the diagnosis of PA.

Our study shows sensitivity and specificity of MR imaging of 83.33 % & 66.67 % respectively this matches the results of **Warshak et al 2006**, **Dwyer et al 2008** that show overall sensitivity and specificity of MR imaging have been given as 80%–88% and 65%–100%, respectively. These rates are relatively similar to those cited for US, and several studies like Mohamed AG, et al 2012 stated have reported no significant differences in the overall accuracy of MR imaging versus sonography (**Warshak et al 2006**), (**Dwyer et al 2008**), (**Mohamed et al 2012**).

The sonographic features of placenta accreta include loss of the normal retroplacental clear space, anomalies of the bladder-myometrium interface, prominent placental lacunae, and increased vascularity at the interface of the uterus and bladder (**Dwyer et al 2008**). Of these various sonographic features, the presence of prominent placental lacunae has the highest positive predictive value (**Comstock et al 2004**). Lacunae are characterized by ill-defined margins, irregular shape, and turbulent flow.

MR imaging may be superior to US in some settings owing to improved soft-tissue contrast and wider field of view; also better assessment of

posterior location of the placenta with lack of adequate visualization, multiple previous cesarean deliveries especially with anterior placenta and anterior placenta with poor visualization of the region of the cesarean scar on sonography, however, MRI is limited by cost, patient claustrophobia, and limited availability of both imaging unit technology and skilled image interpretation.

Although MR imaging uses no ionizing radiation, the safety of MR imaging during pregnancy remains uncertain (**Derman et al 2011**).

Some investigators used gadolinium-based contrast agents to improve the specificity of MRI for diagnosis of PA by better defining the outer placental surface and myometrium (**Warshak et al 2006**). They employed dynamic gadolinium-enhanced (dose up to 0.1 mM/kg) imaging in the arterial, venous, and equilibrium phases over the identical slices, perpendicular to the plane of the placenta-uterine interface, after the plane imaging. This shows early intense lobular enhancement of placenta and subsequent enhancement of myometrium. They reported on 39 cases of confirmed placenta accreta with an unpaired study design. Sonography had sensitivity of 77% and specificity of 96%. Magnetic resonance imaging with gadolinium had sensitivity of 88% and specificity of 100%. Although no detrimental effects of gadolinium-based contrast agents on the human fetus were shown, these agents do cross the placenta (**Baughman et al 2008**).

Therefore, the American College of Radiology guidance document for safe MRI practices recommends that intravenous gadolinium should be avoided during pregnancy and should be used only if absolutely essential (**Kanal et al 2007**). One limitation of our study is that we had a relatively small sample size as it is a prospective study in comparison to most of published retrospective studies.

Conclusion:

MR imaging enabled the diagnosis of placenta accreta, in cases at which sonography is inconclusive. MRI as a complementary technique can help in diagnosis of placenta accreta by additional information in ultrasound doubtful cases (as in patients showing placenta previa with doubtful sonographic features of placenta accreta, posterior location of the placenta with lack of adequate visualization, multiple previous cesarean deliveries especially with anterior placenta and anterior placenta

with poor visualization of the region of the cesarean scar on sonography).

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