

Diagnostic Accuracy of Magnetic Resonance Imaging in Invasive Placentation taking Histopathology as a Gold Standard.

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ABSTRACT

Background: In addition to ultrasound, magnetic resonance imaging (MRI) also helps in prenatal diagnosis of the adherent placenta and ultimately reduces maternal mortality and morbidity. There have also been several studies in Western countries regarding the prenatal diagnosis of adherent placentas on imaging, but there are few in Pakistan. The objective of this study is to investigate the diagnostic accuracy of MRI in invasive placentation in comparison with histopathology.

Methodology: From July 2021 to December 2021, a cross-sectional prospective study was conducted in the Radiology Department at Hayatabad Medical Complex Peshawar Pakistan. In this study, 60 antenatal patients with adherent placentas who were clinically suspected to be high-risk were included. In this study, MRI was used to diagnose adherent placenta with sensitivity and specificity.

Results: Results showed that 20 patients had accurate MRI diagnosis of adherent placentas, while 4 patients missed the diagnosis, resulting in 83.3% sensitivity and 77.7% specificity.

Conclusion: Using the results of our study, radiologists will be able to increase the accuracy of their workup of high-risk patients and enhance multidisciplinary delivery planning to improve maternal outcomes.

Keywords: Invasive placentation, MRI, ultrasound, placenta, accrete spectrum.

INTRODUCTION

When the decidua basalis is deformed, the chorionic villi colonize the myometrium, causing placenta accreta [1]. Placenta accreta spectrum includes placenta accreta, placenta increta, and placenta percreta, depending on myometrium involvement [2]. Villi penetrate the myometrium but not the muscle in placenta accreta. In fact, abnormal placentas can cause massive bleeding and increase maternal mortality and morbidity [3; 4]. Myometrium and placenta interact at the placenta-myometrium interface. T2WI on MRI shows a retroplacental dark band, corresponding to a vintage placental hypoechoic zoster [4]

PAS is associated with a low-lying placenta and past uterine operations, particularly cesarean sections. The prevalence of PAS is growing, and it is the leading cause of urgent postpartum hysterectomy, according to many studies [5]. This is caused by a lack of decidua basalis around the scar. As well as a low-lying placenta, a prior cesarean section increases the risk even further. There is an 11 percent higher chance of adhering placenta in women with both a low-lying coastal placenta and a history of cesarean section compared to women with placenta previa alone, who have a 3% chance of adhesive placenta. Placenta previa patients who have had multiple cesarean procedures are more likely to have an attached placenta. Three previous cesarean sections increase this risk from 40% to 61%. Undoubtedly, cesarean sections are a major cause of attached placentas [6; 7]. Having more than one child, having a uterus that was born with abnormalities, or having had uterine surgery in the past are also risk factors [8].

To aid in surgical planning, patients with a presumption of an attached placenta should undergo a radiological study to assess the severity of myometrial invasion [9] MRI is used to assess placenta accreta after ultrasound, which is used to visualize adherent placentas. When ultrasound yields equivocal results, magnetic resonance imaging (MRI) should be used first. Placenta accreta is more likely to occur in patients with an adherent placenta when ultrasound assessment is ambiguous or when there is a high clinical risk for placenta accreta. In cases where an ultrasound confirms PAS, an MRI is needed to schedule a cesarean section and hysterectomy during the peripartum period. In order to provide an accurate assessment of PAS and reduce maternal and fetal mortality, radiologists need to be familiar with the typical protocols and imaging results of MRI [11].

It is recommended to evaluate placenta accrete using MRI between 24 and 30 weeks of pregnancy because the placenta has homogeneous signals and the myometrium is clearly distinct as well. [12]. In contrast to the first 24 weeks of pregnancy, in which

the placenta has not yet fully developed, after 30 weeks of gestation the placenta has matured and become heterogeneous. MRI can also detect variations in myometrium signals over gestational ages. The three layers of the myometrium can be seen clearly before 30 weeks of gestation. As the myometrium thins out, the appearance of three layers is lost after 30 weeks (13).

A typical placenta will appear as linear hypoechoic bands on T2WI, and its narrow and regular septa will appear as consistent signal intensity on MRI. A pattern of linear signal voids can be seen in the retroplacental region, which represents typical vascularity. In an MRI, the myometrium can be seen to have three different layers. In the outer and inner layers, T2WI signal strengths are lower, while in the middle layer, they are medium (14). Attached placenta is associated with abnormal MRI findings including uterine bulges manifesting as outward contour protrusions. Heterogeneous placenta signals on ultrasonography may also indicate aberrant placentation when bleeding or lacunae are present. Dark intraplacental bands may also be visible on T2WI scans in patients with placental invasion. As opposed to typical placenta septa, these bands have varying thicknesses and are randomly distributed. The absence of black intraplacental bands in the placenta and homogeneous signals from the placenta rule out adherent placenta. (15). It becomes harder to evaluate the uterine myometrium as pregnancy progresses due to a reduction in thickness. However, if the myometrium is drawn in detail, localized fractures in the myometrium could be detected at the site of placental invasion (16) Placenta percreta occurs when placental tissue grows beyond the myometrium into nearby viscera. When the placenta invades or strains the bladder, it is a strong indicator of placenta percreta (17).

Radiologists need a diagnostic imaging strategy that will boost diagnostic accuracy through this study, which highlights the role MRI plays in evaluating PAS. Patients' outcomes will ultimately be improved as a result of this improvement in treatment plan.

The purpose of the study is to compare diagnostic accuracy of MRI in invasive placentation with histopathology.

METHODS AND MATERIAL

Study design and setting: A cross-sectional study was conducted in the Radiology department of Hayatabad Medical Complex Peshawar, Pakistan, from July 2021 to December 2021, which is a tertiary care hospital.

Data collection: The study collected data from 60 pregnant high-risk patients who had symptoms suggesting placenta accretion and were referred to the Radiology department for an MRI test. Participants in the study comprised all prenatal patients whose gestational ages ranged from 22 to 32 weeks and who had risk factors such as placenta previa, a history of cesarean section, or other uterine procedures. Patients who did not have any risk factors and who had a gestational age of less than 22 weeks or greater than 32, weeks were not included in the study. The review board for the institution gave their clearance to the currently ongoing study.

Sample size: In this study, 60 antenatal patients with adherent placentas who were clinically suspected to be high-risk were included. In this study, MRI was used to diagnose adherent placenta with sensitivity and specificity.

Experimental test: The outcomes of an ultrasound examination that was carried out using a curvilinear probe with a frequency of 5.0 MHz and carried out on an Aloka ultrasound Doppler machine by a single sonologist were recorded. After that, a 1.5 tesla machine equipped with a surface coil was used to conduct the MRI test.

MRI test: The MRI test lasted for fifteen to twenty minutes, during which time the patient was required to lie in the supine position and have their urinary bladder completely full. Techniques involving the suppression of breathing were utilized in an effort to reduce motion artifact. Within the region of the contact between the placenta and the myometrium, axial, sagittal, & coronal sections were obtained.

Statistical Analysis: Demographic data were imported into an Excel file (Microsoft Corporation, Washington, DC, USA). Categorical variables were shown as a quantity with percentage (%) of the sample.

RESULTS

A total of sixty individuals were given an MRI in order to evaluate possible placenta accreta, with histology serving as the gold standard. In a total of 60 cases, the presence of an adhering placenta was established by histology in 24 patients. The MRI properly diagnosed the adhering placenta in 20 patients. However, eight patients were given a false positive result on the MRI, and four patients were provided with an incorrect negative result on the MRI. The total number of patients who got a diagnosis for placenta accrete from an MRI was 28. The final results of an MRI showed that its sensitivity was 83.3%, while its specificity was only 77.7%. (Table 1).

Table 1: Sensitivity and Specificity of MRI

	<i>Sensitivity%</i>	<i>Specificity%</i>	<i>Positive predictive value</i>	<i>Negative predictive value</i>
<i>MRI</i>	83.3%	77.7%	71.4%	87.5%

According to the findings of our research, 83.3% of patients who had invasive placentation also had the health risks of placenta previa as well as a history of uterine or cesarean section (Table 2).

Table 2: Risk factors in Patients with Invasive Placentation

<i>Risk factors</i>	<i>No. of Patients(n)</i>	<i>Percentage</i>
<i>Placenta Previa only</i>	n=1	4.2%
<i>Previous Cesarean Section</i>	n=3	12.5%
<i>Both Placenta Previa& Prior cesarean section</i>	n=20	83.3%

The average age of our patient was 36 years while average parity was 3. (Table 3).

Table 3 : Clinical information of patients

<i>Average age</i>	36 years
<i>Parity</i>	3

Among a total of 60 patients, placenta previa was identified in 54 of them, and the anterior position was the most prevalent placement for placenta previa (64.8% of cases). Table 4.

Table 4: Placental insertion in patients with previa

<i>Placental Insertion</i>	<i>No. of patients(N=54)</i>	<i>Percentage</i>
<i>Anterior</i>	N=35	64.8%
<i>Posterior</i>	N=14	25.9%
<i>Low lying</i>	N=5	9.2%

On MRI common findings were T2WI dark intra placental bands and heterogeneous placenta signals (Figure.1).

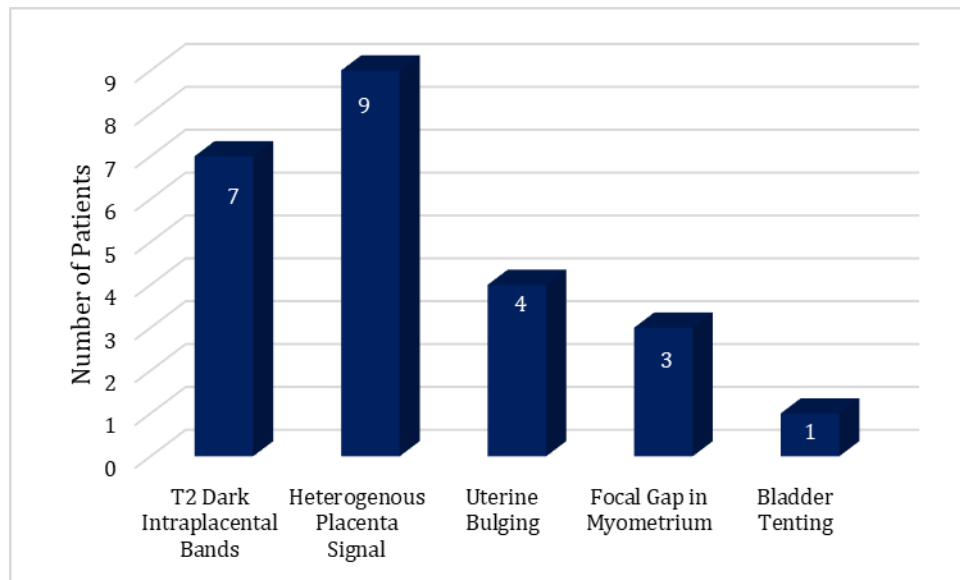


Figure 1: MRI findings of Placenta accreta

In addition, the ultrasonographic results of an attached placenta were documented. Intraplental lacunae were observed to be present in 86% of pregnancies that underwent ultrasound examination. Other typical ultrasound findings included aberrant vascularity of the placenta and a lack of the typical hypoechoic retroplacental zone. (Figure no.2)

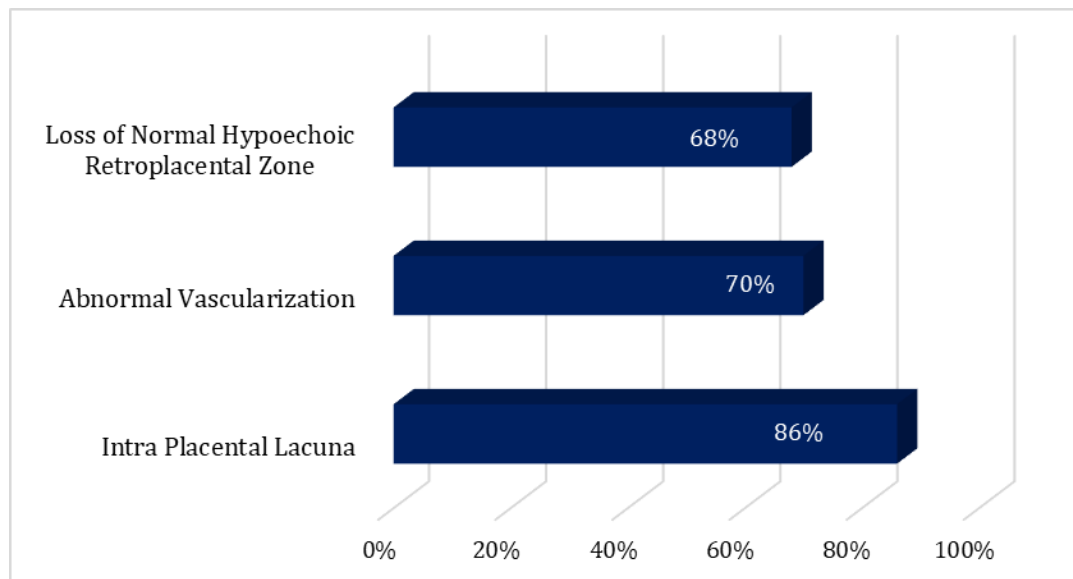


Figure 2: Ultrasound findings of placenta accreta

DISCUSSION

Increasing rates of cesarean sections are likely to be responsible for the rise in invasive placentation over the past few decades (18). During invasive placentation, placental villi infiltrate the myometrium, causing postpartum bleeding. It is a common contributor to the morbidity and mortality of mothers. It is of the utmost necessity to make a prenatal diagnosis of invasive placentation in order to make an informed decision on the appropriate mode of birth planning and care (19). Ultrasounds and magnetic resonance imaging (MRI) are both extremely helpful imaging modalities for diagnosing invasive placentation. Even though MRI is less accurate than ultrasound, it is very useful for patients with increased BMI, in posterior placentas, and when ultrasound results are ambiguous. Ultrasound is the first the preferred method due to its high sensitivity, cost effectiveness, and easy availability (20). In recent years, MRI is now regarded modality of choice for invasive placentation. MRI is also able to

accurately describe the width and depth of placental invasion (21). The common findings of invasive placentation on MRI include diverse placenta, T2 dark intraplacental bands, focal uterine bulge, and focal myometrium interruption; however, none of these findings are specific on MRI (22).

The specificity and sensitivity of MRI for trying to diagnose invasive placentation were 83.3% and 77.7% respectively in our research; these results are comparable (20), who found specificity and sensitivity on MRI to be 84% and 78% respectively. In another investigation, (23) discovered that the specificity and sensitivity of their test was 88.33 percent and 85.1 percent, respectively. On the other hand, (21) discovered a sensitivity of 100% and a specificity of 92%. This disparity in results is most likely the result of differing demographics and the fact that the investigation was conducted retrospectively.

On MRI, the most typical manifestation of intrusive placentation was a diverse placenta with dark intraplacental bands on T2. These findings are analogous to those found in the research conducted by (24), they discovered a heterogonous placenta in 63% of cases and black intraplacental bands in 45% of cases. It also fits in well with the findings of (15) results.

Our research also shown that the presence of placenta previa as well as a history of previous cesarean surgery significantly enhances the likelihood of invasive placentation. In addition (25), shown that placenta previa and a history of cesarean surgery are also risk factors for adhering placenta. Our results are in accordance with previous studies (7; 26).

Our study has some limitation. In the first place, the sample size of our study was quite small, which makes generalizing the results difficult. Secondly, without considering other factors such as having multiple children, being overweight, or being an older mother. While data was gathered from one hospital, comprehensive data collection from multiple locations in Pakistan would have provided a more accurate picture of the outcomes. A large sample of patients should be studied further, especially to examine whether other, less significant risk factors are associated with intrusive placentas.

CONCLUSION

There are a number of complications associated with invasive placentation, including excessive bleeding, damage to pelvic organs, and eventually the need for a hysterectomy through cesarean section. It is possible to avoid these issues if invasive placentation is detected early during pregnancy using imaging techniques such as ultrasound and MRI. Due to the rarity of invasive placentation and the difficulty of collecting data from a large sample, less scientific research has been done about the particular MRI features associated with invasive placentation. MRI increases the accuracy of the workup of adherent placenta patients and aids to radiologists to provide more appropriate treatment for patients with invasive placentation, resulting reduction in mortality and morbidity.

CONFLICT OF INTEREST: Authors have no conflict of interest.

References

1. Mazouni C, Gorincour G, Juhan V, Bretelle F. Placenta accreta: a review of current advances in prenatal diagnosis. *Placenta*. 2007 Jul 1;28(7):599-603.
2. Srisajjakul S, Prapaisilp P, Bangchokdee S. MRI of placental adhesive disorder. *The British journal of radiology*. 2014 Oct;87(1042):20140294.
3. Baughman WC, Corteville JE, Shah RR. Placenta accreta: spectrum of US and MR imaging findings. *Radiographics*. 2008 Nov;28(7):1905-16.
4. Derman AY, Nikac V, Haberman S, Zelenko N, Opsha O, Flyer M. MRI of placenta accreta: a new imaging perspective. *American Journal of Roentgenology*. 2011 Dec;197(6):1514-21.
5. Wu S, Kocherginsky M, Hibbard JU. Abnormal placentation: twenty-year analysis. *American journal of obstetrics and gynecology*. 2005 May 1;192(5):1458-61.
6. Hung TH, Shau WY, Hsieh CC, Chiu TH, Hsu JJ. Risk factors for placenta accreta. *Obstetrics & Gynecology*. 1999 Apr 1;93(4):545-50.
7. Silver RM, Landon MB, Rouse DJ, Leveno KJ, Spong CY, Thom EA, Moawad AH, Caritis SN, Harper M, Wapner RJ, Sorokin Y. Maternal morbidity associated with multiple repeat cesarean deliveries. *Obstetrics & Gynecology*. 2006 Jun 1;107(6):1226-32.
8. Japaraj RP, Mimin TS, Mukudan K. Antenatal diagnosis of placenta previa accreta in patients with previous cesarean scar. *Journal of Obstetrics and Gynaecology Research*. 2007 Aug;33(4):431-7.

9. Budorick NE, Figueroa R, Vizcarra M, Shin J. Another look at ultrasound and magnetic resonance imaging for diagnosis of placenta accreta. *The Journal of Maternal-Fetal & Neonatal Medicine*. 2017 Oct 18;30(20):2422-7.
10. Mar WA, Berggruen S, Atueyi U, Sekhon S, Garzon SA, Knuttinen MG, McGahan JP. Ultrasound imaging of placenta accreta with MR correlation. *Ultrasound Quarterly*. 2015 Mar 1;31(1):23-33.
11. Jauniaux E, Collins S, Burton GJ. Placenta accreta spectrum: pathophysiology and evidence-based anatomy for prenatal ultrasound imaging. *American journal of obstetrics and gynecology*. 2018 Jan 1;218(1):75-87.
12. Masselli G, Gualdi G. MR imaging of the placenta: what a radiologist should know. *Abdominal imaging*. 2013 Jun;38:573-87.
13. Horowitz JM, Berggruen S, McCarthy RJ, Chen MJ, Hammond C, Trinh A, Gabriel H. When timing is everything: are placental MRI examinations performed before 24 weeks' gestational age reliable?. *American Journal of Roentgenology*. 2015 Sep;205(3):685-92.
14. Bour L, Placé V, Bendavid S, Fargeaudou Y, Portal JJ, Ricbourg A, Sebbag D, Dohan A, Vicaut E, Soyer P. Suspected invasive placenta: evaluation with magnetic resonance imaging. *European radiology*. 2014 Dec;24:3150-60.
15. Lax A, Prince MR, Mennitt KW, Schwebach JR, Budorick NE. The value of specific MRI features in the evaluation of suspected placental invasion. *Magnetic resonance imaging*. 2007 Jan 1;25(1):87-93.
16. Kim JA, Narra VR. Magnetic resonance imaging with true fast imaging with steady-state precession and half-Fourier acquisition single-shot turbo spin-echo sequences in cases of suspected placenta accreta. *Acta radiologica*. 2004 Oct 1;45(6):692-8.
17. Yang A, Xiao XH, Wang ZL, Wang ZY, Wang KY. T2-weighted balanced steady-state free precession MRI evaluated for diagnosing placental adhesion disorder in late pregnancy. *European Radiology*. 2018 Sep;28:3770-8.
18. Diag FP, Jauniaux E, Ayres-de-Campos D, Tikkanen M. FIGO consensus guidelines on placenta accreta spectrum disorders: introduction. *International Journal of Gynecology & Obstetrics*. 2018.
19. Washecka R, Behling A. Urologic complications of placenta percreta invading the urinary bladder: a case report and review of the literature.
20. de Marcillac FD, Molière S, Pinton A, Weingertner AS, Fritz G, Viville B, Roedlich MN, Gaudineau A, Sananes N, Favre R, Nisand I. Accuracy of placenta accreta prenatal diagnosis by ultrasound and MRI in a high-risk population. *Journal de gynécologie, obstétrique et biologie de la reproduction*. 2016 Feb;45(2):198-206.
21. Fiocchi F, Monelli F, Besutti G, Casari F, Petrella E, Pecchi A, Caporali C, Bertucci E, Busani S, Botticelli L, Facchinetti F. MRI of placenta accreta: diagnostic accuracy and impact of interventional radiology on foetal-maternal delivery outcomes in high-risk women. *The British journal of radiology*. 2020 Oct 1;93(1114):20200267.
22. Mahalingam HV, Rangasami R, Premkumar J, Chandrasekar A. Placenta accreta scoring system (PASS)—assessment of a simplified clinico-radiological scoring system for antenatal diagnosis of placenta accreta. *Egyptian Journal of Radiology and Nuclear Medicine*. 2021 Dec;52:1-6.
23. Khan N, Mughal HH, Khaliq M, Hanif M. Accuracy of magnetic resonance imaging in diagnosing morbidly adherent placenta. *Journal of The Society of Obstetricians and Gynaecologists of Pakistan*. 2021 Apr 7;11(1):5-9.
24. Magied AM, Eldin LA, Tohamey YM, Abd El Kader MA. Placenta previa; MRI as an adjunct to ultrasound in assessment of suspected placental invasion. *The Egyptian Journal of Radiology and Nuclear Medicine*. 2018 Mar 1;49(1):284-91.
25. Kyojuka H, Yamaguchi A, Suzuki D, Fujimori K, Hosoya M, Yasumura S, Yokoyama T, Sato A, Hashimoto K. Risk factors for placenta accreta spectrum: findings from the Japan environment and Children's study. *BMC pregnancy and childbirth*. 2019 Dec;19:1-7.
26. Balcacer P, Pahade J, Spektor M, Staib L, Copel JA, McCarthy S. Magnetic resonance imaging and sonography in the diagnosis of placental invasion. *Journal of Ultrasound in Medicine*. 2016 Jul;35(7):1445-56.