

Accuracy of MRI in Diagnosis of Invasive Placenta by Taking Per Operative Findings as Gold Standard

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ABSTRACT

Objective: To assess the diagnostic accuracy of magnetic resonance imaging (MRI) in detecting invasive placentas using per-operative findings as the gold standard.

Methodology: A prospective cross-sectional study was conducted in the diagnostic radiology department of KRL General Hospital Islamabad during Oct 2019 to Sep 2021. Sixty prenatal individuals were identified as having a high risk of invasive placenta and underwent MRI (Phillips 1.5 T) to confirm the diagnosis. A trainee radiologist and a consultant radiologist reviewed the images. The MRI's sensitivity, specificity, positive predictive value, negative predictive value, and accuracy was calculated using a 2x2 contingency tables.

Results: Ten cases of invasive placenta were detected postoperatively (gold standard). The MRI had a sensitivity of 90%, a specificity of 93%, a positive predictive value of 90%, a negative predictive value of 90%, and an accuracy of 92.3 percent, respectively.

Conclusion: The study concluded that magnetic resonance imaging (MRI) offers a good diagnostic accuracy and is a reproducible technology for prenatal identification of invasive placentas.

Keywords: Invasive Placenta, Magnetic Resonance Imaging, Prenatal Diagnosis

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Introduction

Maternal mortality and morbidity are significant risks during pregnancy and childbirth. ¹ More than 10% of all pregnancies are adversely affected by invasive placentation, the most severe form of placental adhesion. A defective decidua basalis layer allows chorionic villi to enter the myometrium in this condition. ² It is estimated that an invasive placenta is responsible for one percent of all pregnancy-related hemorrhage and deaths. There is a significant maternal morbidity and mortality from hysterectomy in more than half of all hemorrhages. ³

There are three types of invasive placenta, each with a different degree of myometrial invasion: "Placenta Accreta" which is confined to the uterine lining and does not penetrate it; "placenta Invaginata" that invades the uterine lining. Myometrium invasion and penetration are referred to as "placenta increta" and "placenta percreta,"

respectively. ⁴ The presence of invasive placenta ranks third on Pakistan's list of reasons for hysterectomy after uterine rupture and atony. At least 10 placentas because of previa and previous uterine procedures, such as caesarean sections or myomectomy, invasive placenta is more likely. ⁵

An increasing number of invasive placentas have been found over the last three decades. C-sections are the most common method of acquiring an invasive placenta, and as a result, the procedure carries an eight-fold risk premium. ⁶ Prior to scheduling a life-threatening C-section in an advanced care centre with newborn and maternal intensive care units, blood products, and multidisciplinary specialists, rapid prenatal diagnosis is important. ⁷

Ultrasonography has a sensitivity and specificity of about 90% for diagnosing an invasive placenta. An

inexperienced operator, lack of history, obesity, and a posteriorly-placed placenta can all affect the accuracy of ultrasound imaging.⁸ MRI can detect an invasive placenta, although it is more expensive and less accurate than USG.⁹

This is due to the entire image of placental invasion provided by MRI. There is no issue for MRI with the posterior placenta and obesity, and worldwide guidelines suggest it.¹⁰ Previa and invasive placenta can both be overestimated by early MRIs, thus it's better to hold out on getting one until 36 weeks. Placental invasion can potentially be exaggerated by future MR studies.¹¹ The presence of intraplacental dark bands, uterine bulging, changing uterine signal intensity, placental lacunae with hyperintensity, and placental implantation on a previous C-section scar might all be indicators of an invasive placenta.¹²

Early prenatal identification using MRI is the key to reducing the significant death and morbidity rates that are commonly linked with invasive placenta. Our study aimed to evaluate the diagnostic accuracy of MRI to detect invasive placentas using the gold standard of findings obtained during surgery.

Methodology

Maternal mortality and morbidity are significant risks during pregnancy and childbirth.¹ More than 10% of all pregnancies are adversely affected by invasive placentation, the most severe form of placental adhesion. A defective decidua basalis layer allows chorionic villi to enter the myometrium in this condition.² It is estimated that an invasive placenta is responsible for one percent of all pregnancy-related hemorrhage and deaths. There is a significant maternal morbidity and mortality from hysterectomy in more than half of all hemorrhages.³

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Results

Sixty-Nine patients who fulfilled inclusion criteria underwent MRI. Patients were between 28 – 40 years of age with a mean age of 32.2 years. Out of these 30 patients had parity 1-3 (43.46%) and 39 had parity >3 (61.5%). According to this study, as the number of previous cesarean sections increased, so did the prevalence of invasive placentation in those patients who had more previous C sections. Findings were recorded in Table I.

Out of Sixty-Nine patients, the invasive placenta was confirmed per operatively in 53 patients. MRI correctly

diagnosed invasive placenta in 49 patients (True positives) while it falsely diagnosed invasive placenta in 4 patients (false positive). Preoperatively, 5 of 16 patients with negative MRI results was diagnosed with invasive placentation (false negative), even though the scans had ruled out 11 possible scenarios (True negatives), as shown in Table II.

The sensitivity, specificity, PPV, NPV, and diagnostic accuracy of MRI were 90.74%, 73.33%, 92.45%, 68.75%, and 86.95%, as shown in Table III.

Results of MRI features of invasive placenta were also assessed. Lower uterine bulge and focal disruption of the hypointense myometrial layer is seen in Figure I. Reduced myometrial thickness and dark intra placental bands are seen in figure II.

Table I: Comparison of the number of previous C-sections with the frequency of invasive placentation.

No. of previous C-Sections	Invasive placenta preoperatively	Percentage
1	5	7.24%
2	7	10.14%
3	18	26.08%
4	39	56.54%
Total	69	100%

Table II: Comparison of Preoperative Findings vs MRI

MRI	Per Operative finding		Total
	Yes	No	
YES	49	4	53
NO	5	11	16
Total	54	15	69

Table III: Diagnostic Value of MRI in Comparison of Preoperative Findings

Diagnostic Test	Value
Sensitivity	90.74%
Specificity	73.33%
Positive Predictive Value	92.45%
Negative Predictive Value	68.75%
Diagnostic Accuracy	86.95%

Discussion

Prenatal diagnosis of PA using the most commonly used diagnostic tools was the goal of this study. The findings on ultrasound were similar to the findings of an Egyptian study published in 2019.¹⁴

We only used MRI in cases that were high risk due to the high cost and restricted availability of this technique. Also, the MRI results were in accordance with earlier ones. Positive and negative predictive values were high, as were sensitivity, specificity, and negative predictive values for the Ultra Sound. MRI can be a problem-solving tool, although it is most beneficial in the most demanding circumstances. Sensitivity and specificity measurements verified this.



Figure I. Showing T2 weighted sagittal image in one of the patients showing focal disruption of the hypointense myometrial layer.

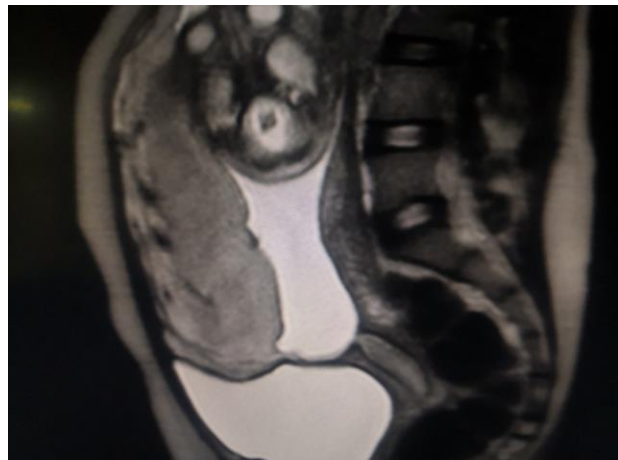


Figure II. Showing T2 weighted sagittal image in a patient showing Intra placental.

In a study at the University of Medical Sciences, Masshad, Iran, MRI sensitivity and specificity were found to be 76 and 83%, while our study found sensitivity of 90.74 percent and specificity of 73.33%.¹⁵

The US method of prenatal diagnosis was selected as the basis for our prenatal diagnostics because it is widely

available and simple to use. Although MRI is more expensive and does not match the PA criteria, most pregnant women are already familiar with the procedure known as sonography.¹⁶ On the basis of non-contrast magnetic resonance imaging, our study was conducted (MRI). According to Warshak et al.¹⁷ Sensitivity was 77% and specificity was 96%, however, in our investigation, sensitivity was 90% and specificity was 73%.

Our study reported a sensitivity of 90.74 percent and specificity of 73.33 percent for MR diagnostic accuracy, while a study at Holy Family Hospital¹⁸ found an overall MR diagnostic accuracy of 86.92 percent. This study's findings are comparable to those of other research.¹⁹

According to a study done at CMH Quetta Pakistan, MRI and ultrasound had good sensitivity and accuracy for detecting placenta accreta in patients with previous scars, which is similar to our results.²⁰

Othman AIA et al²¹ has shown the sensitivity and specificity of MRI in diagnosing MAP as 100.0% and 85.7% respectively⁹ 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.²²

Limitations: Small sample size was a limitation of our study.

Conclusion

Because of its accuracy, magnetic resonance imaging (MRI) can help doctors better diagnose Morbidly Adherent Placenta (MAP) and benefit patients as well. We recommend it as the main screening method for correct detection of MAP because it is accurate and non-invasive.

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