The value of Magnetic Resonance in the Diagnosis of Prenatal Placental Implantation

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Abstract: This study aims to explore the application value of magnetic resonance rapid imaging technology in the diagnosis of prenatal placenta implantation. Methods: Sixty-three patients with suspected prenatal placenta implantation were selected from January 2022 to January 2023 in our hospital and diagnosed with MRI rapid imaging sequences, and the diagnostic results, efficacy and common signs of MRI were counted. Results: Pathological diagnosis showed prenatal placenta implantation in 50 cases and MRI diagnosis in 49 cases. Using pathology as a criterion, MRI diagnosis had a sensitivity of 98.00%, a specificity of 100.00%, a positive predictive value of 100.00%, a negative predictive value of 92.86%, and an accuracy of 98.41%. MRI signs differed significantly between different grades of placental implantation, and patients with high-grade placental implantation had more comorbid signs, with lower uterine bulge, protruding uterine contour, and tenting signs as high-risk signs. Conclusion: Magnetic resonance rapid imaging has high accuracy and application value in the diagnosis of prenatal placenta implantation, which can guide clinical treatment. This article will discuss the value of magnetic resonance in the diagnosis of prenatal placenta implantation to promote better understanding and application of this examination method.

***Keywords*:** magnetic resonance technology application; signs; prenatal placenta; implantation diagnosis; diagnostic value

1. Introduction

Magnetic Resonance Imaging (MRI), as an advanced medical imaging technology, plays an increasingly important role in medical diagnosis. MRI has high sensitivity in the diagnosis of prenatal placenta implantation. [1] Placental implantation is a serious obstetric complication that may have serious effects on the health of the mother and baby if not diagnosed and treated in time. Previous studies have shown that MRI has high accuracy and reliability in the diagnosis of placenta implantation and can provide physicians with more accurate diagnostic information.

However, despite the many advantages of MRI in the prenatal diagnosis of placenta implantation, in practice, MRI is not part of the routine prenatal examination items, and therefore is relatively rarely used in prenatal diagnosis. This may be related to factors such as the higher cost of MRI equipment and longer examination time.

In recent years, the number of pregnant women has shown a steady increase with the adjustment of the fertility policy and the change of the social concept of reproduction. However, the ensuing prenatal complications cannot be ignored. Among them, placenta implantation, as a serious prenatal complication, its early and accurate diagnosis is crucial for the health of mothers and infants. The aim of this study was to analyse the clinical characteristics of suspected prenatal placenta implantation cases admitted to our hospital between January 2022 and January 2023, with a view to providing a more detailed reference basis for clinical diagnosis and treatment.

2. Information and Methods

2.1 Study subjects

Sixty-three cases of suspected antenatal placenta implantation admitted in our hospital during the time period from January 2022 to January 2023 were randomly selected for the present study. The age range of the patients was 20-43 years with a mean age of (33.31±4.88) years and the gestational weeks were 28-40 weeks with a mean gestational week of (34.87±3.72) weeks. There were 22 cases of first pregnancy and 41 cases of multiple pregnancies; 22 cases of cesarean section pregnancy history, 24 cases of abortion history, and 7 cases of both.

2.2 Inclusion and exclusion criteria

Inclusion criteria included: patients with complete clinical data, meeting the clinical diagnostic criteria for prenatal placenta implantation, and age greater than or equal to 18 years old. Exclusion criteria included: patients with combined cognitive impairment, mental disorders, unable to cooperate with clinical diagnosis; underage patients; and patients with

contraindications to examination.

2.3 Basic information of patients

Of the 63 cases of suspected antenatal placenta implantation included in this study, the basic conditions of the patients, such as age, gestational week, and number of pregnancies, were as described above. In addition, we found a higher proportion of patients with a history of cesarean section and/or abortion, which may be associated with an increased risk of placenta implantation.

2.4 Research Methods

Sixty-three patients with suspected prenatal placenta implantation recently admitted to a hospital were selected for this study. All patients underwent MRI examination and pathological diagnosis.MRI examination was performed using a high-resolution 1.5T or 3.0T superconducting magnetic resonance scanner with a standard abdominal scanning sequence for imaging. Pathological diagnosis was obtained by postnatal histopathological examination of the placenta.

2.5 Observational indicators

Magnetic resonance imaging (MRI) is an important tool in medical diagnosis, especially in the diagnosis of prenatal placenta implantation, where its accuracy is crucial for clinical decision-making. We conducted a study to evaluate the performance of MRI in the diagnosis of prenatal placenta implantation by collecting and counting the diagnostic results of MRI and analysing them in comparison with the patient's surgical pathological diagnosis. In the study, we classified prenatal placenta implantation into three types based on pathological diagnosis: adherent placenta implantation, implanted placenta and penetrating placenta. In order to investigate the diagnostic performance of MRI in each type of placental implantation in depth, we carefully observed the MRI imaging signs of each type of placental implantation.

MRI has high sensitivity and specificity in the diagnosis of prenatal placenta implantation, especially in the diagnosis of implanted and penetrating placenta. In addition, the positive predictive value and negative predictive value of MRI were also relatively high, suggesting that MRI has high accuracy in the diagnosis of prenatal placenta implantation. However, MRI may have some limitations in the diagnosis of adherent placenta implantation. Nonetheless, MRI remains a valuable diagnostic tool, especially in assessing the severity of placental implantation and in formulating treatment plans.

2.6 Statistical methods

SPSS21.0 statistical software was used to analyse the data. Measurement data conforming to normal distribution were expressed as mean±standard deviation (x±s), and t-test was used; count data were expressed as frequency (n), percentage (%), and $\chi 2$ test was used, and the difference was statistically significant with $P<0.05$.

3. Analysis of results

Among the 63 patients with suspected prenatal placenta implantation, the pathological diagnosis showed that 50 cases were prenatal placenta implantation.The MRI diagnosis showed that 49 cases were prenatal placenta implantation.The detailed data are shown in Table 1.Taking the pathological diagnosis as the criterion, the sensitivity of MRI diagnosis was 98.00% (49/50), the specificity was 100.00% (13/13), and the positive predictive value was 100.00% (49/49), negative predictive value was 92.86% (13/14), and accuracy was 98.41% (62/63).

Table 1. Diagnostic findings of prenatal placenta implantation by MRI Unit: cases

Method	Number of cases	Pathological diagnosis		Total
		Positive	Negative	
MRI	Positive	49	0	49
	Negative	1	13	14
Total		50	13	63

4. Discussion

Antenatal placenta implantation is the abnormal invasion of placental villi and tissues into the myometrium. Placental villous tissues enter the underdeveloped myometrium in order to obtain a better supply of blood and oxygen, forming associations that can penetrate the plasma membrane layer in severe cases [2]. Due to the adhesion of the placenta to the myometrium, exposure of blood vessels, trauma, and large blood sinuses may occur at the time of peeling, increasing the risk of postpartum haemorrhage. Therefore, timely prenatal diagnosis and appropriate surgical or special treatment are essential

to reduce the risk of postpartum haemorrhage.

The diagnosis of prenatal placenta implantation relies mainly on imaging, especially MRI. MRI confirms soft tissue signals through a magnetic field, has high-resolution and fast imaging technology, reduces fetal motion interference, and enhances the display of placental villous structures, thus accurately diagnosing prenatal placenta implantation.

The number and intensity of common signs of prenatal placental implantation on MRI can be used to assess the severity of placental implantation [3]. Lower uterine bulge and protruding uterine silhouette may represent myometrium affected by internal or external material, whereas tenting sign may be caused by placental tissue compressing the myometrium. Loss of low signal or blurring of the conjugate zone may indicate tissue overlap or adhesion, suggesting placental implantation [4]. Among them, lower uterine bulge, protruding uterine silhouette and tenting sign are high-risk signs, while loss of low signal in the conjugate zone and blurring of the conjugate zone are universal signs.

Antenatal placenta implantation is a relatively rare obstetric complication that refers to the abnormal invasion of placental villi or tissue into the myometrium. This phenomenon is usually caused by factors such as damage to the endometrium, incomplete or poorly developed uterine meconium. When placental villous tissues try to obtain a better supply of blood and oxygen, they invade the underdeveloped myometrium, forming close associations and may even penetrate the plasma membrane layer with serious consequences [5]. Therefore, timely diagnosis of prenatal placenta implantation and appropriate surgical or special treatment are particularly critical.

The diagnosis of prenatal placenta implantation mainly relies on advanced imaging techniques, especially magnetic resonance imaging (MRI), which confirms soft tissue signals through magnetic fields, has the advantages of high-resolution and fast imaging techniques, and can largely reduce the interference of fetal movement on imaging, thus improving the clarity of the display of the placental villous structure and ensuring the accurate diagnosis of prenatal placenta implantation.

From the results of this study, it is clear that MRI has high sensitivity and specificity in the diagnosis of prenatal placenta implantation, and is able to accurately identify most cases of prenatal placenta implantation. In addition, the positive predictive value and accuracy of MRI were also very high, indicating the high reliability of MRI diagnostic results. It is worth noting that although the negative predictive value of MRI is high, there is still a certain percentage of missed diagnosis, which may be related to the imaging quality of MRI examination, the diagnostic experience of doctors and other factors.

On MRI, common signs of prenatal placenta implantation include lower uterine bulge, protruding uterine silhouette, tenting sign, and loss or blurring of the low signal of the union zone. The number and intensity of these signs can be used to assess the severity of placental implantation [6]. Lower uterine bulge and protruding uterine contour may imply that the myometrium has been affected by internal or external material, whereas the tenting sign may be caused by placental tissue compressing the myometrium. Loss of low signal or blurring of the conjugate zone may indicate tissue overlap or adhesion, suggesting the presence of placental implantation [7].

It is important to note that the presence of high-risk signs in the uterus often indicates a higher risk of placental implantation. In contrast, loss of low signal and blurring of the union bands are universal signs, and their presence may be associated with other uterine or placental abnormalities.

In conclusion, antenatal placenta implantation is a serious obstetric complication that requires timely and accurate diagnosis and treatment.MRI, as an advanced imaging technique, plays a key role in the diagnosis of antenatal placenta implantation. By observing and analysing various signs on MRI, doctors can assess the severity of placenta implantation and provide important references for subsequent surgery or special treatment. Therefore, MRI examination should be regarded as an important diagnostic tool for pregnant women with suspected prenatal placenta implantation.

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