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FULL PAPER

Diagnostic performance of radiologists with different levels of experience in the interpretation of MRI of the placenta accreta spectrum disorder

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Objectives: There have been no investigations on the association between previous abdominopelvic MRI experience without placental MRI experience and diagnostic accuracy of placenta accreta spectrum (PAS). To evaluate the diagnostic performance of radiologists with different experience levels in interpreting PAS-related MRI findings.

Methods: This retrospective study included 60 women who underwent MRI for placental assessment between 2016 and 2020. MR images were reviewed by four radiologists who were blinded to the clinical outcomes and had different experience levels in interpreting PAS-related MRI findings. The radiologists' diagnostic performance was evaluated according to the pathologic and surgical outcomes. Simple κ statistics were calculated to determine agreement among the radiologists.

Results: Of 60 women, 46 were diagnosed with PAS. The maternal age mean ± SD was 33.0 years ± 5.0 for the PAS absent group and 36.0 ± 4.3 for the PAS present group (p = 0.013). Overall, the most experienced radiologist had the highest sensitivity (100%, 95% confidence interval (CI): 92.3–100%) and NPV (100%, 95% CI: 63.1–100%) in PAS diagnoses. However, the PPV and specificity were independent of experience. The most experienced radiologist had the highest diagnostic accuracy in PAS (90%, 95% CI: 79.5–96.2%) and placenta percreta (95%, 95% CI: 86.1–99.0%). There was a strong association between definitive PAS diagnoses and the highest experience level. The κ values for the interobserver agreement regarding PAS diagnoses were 0.67 for the most experienced radiologist (p < 0.001) and 0.38, 0.40, and 0.43 for the other radiologists (p = 0.001) and regarding placenta percreta diagnoses were 0.87 for the senior radiologist (p < 0.001) and 0.63, 0.57, and 0.62 for the other radiologists (p < 0.001).

Conclusion: Previous experience in interpreting PAS-related MRI findings plays a significant role in accurately interpreting such imaging findings. Previous abdominopelvic MRI experience without specific placental MRI experience did not improve diagnostic performance.

Advances in knowledge: We believe that our study makes a significant contribution to the literature and that this paper will be of interest to the readership of your journal because to the best of our knowledge, this study is the first in which the correlation between previous experience in abdominopelvic MRI with no specific experience in PAS-related MRI and diagnostic accuracy of radiologists has been explored. Our results could aid in setting up specialized multidisciplinary teams to assist women with PAS disorders.

INTRODUCTION

Placenta accreta spectrum (PAS) or abnormal invasive placenta (AIP) is characterized by the abnormal invasion of the placental chorionic villi beyond the decidua basalis. Clinically, in PAS, the placenta does not detach spontaneously post-delivery and cannot be forcibly removed without causing massive and potentially life-threatening bleeding.[1,2]

The trophoblastic tissue infiltration into the myometrium and uterine serosa is classified into the following three

degrees: (1) placenta accreta (placental villi adhere onto the superficial myometrium without invasion), (2) placenta increta (villi deeply penetrate the myometrium but not the uterine serosa), and (3) placenta percreta (villi penetrate the serosa and possibly the adjacent organs, such as the bladder and ureters).[3,4]

The main PAS risk factors are placenta previa, prior cesarean sections, uterine instrumentation, and maternal age ≥35 years.[5] The increased PAS incidence, estimated to be 0.79–3.11 per 1000 births after prior cesarean sections, is predominantly attributable to the rising global cesarean section rate and advanced maternal age.[3,4,6,7] Accurate prenatal diagnoses and careful perinatal management strategies are necessary. Patients should preferably be treated in AIP-specialized medical centers.[8]

MRI, a reliable modality for detecting suspected placental invasion, is a complementary method used in case of a suspicion of placental attachment abnormalities on ultrasound. MRI is the preferred imaging modality for treatment planning as it aids in more effectively determining the relationship between the uterus and adjacent structures.[1,9–12] However, some studies have shown that the diagnostic value of MRI in placental evaluations depends on the radiologists' experience level.[13]

The International Society for Abnormally Invasive Placenta (IS-AIP) recommends that patients with PAS should be cared for specialized medical centers staffed by multidisciplinary teams with extensive experience in managing AIP in order to enable antenatal diagnoses and preoperative planning. However, there is currently no evidence regarding what factors constitute "expertise" in AIP management in the literature. The IS-AIP recommendation is based on a consensus opinion (level five evidence) and defines an expert as a person with significant AIP-related experience and a high level of AIP-related knowledge and/or skills (Grade D recommendation).[2] So far, it has not been investigated whether previous abdominopelvic MRI experience with no placental disorder-related MRI experience is associated with PAS diagnostic accuracy.

Here, we aimed to evaluate the diagnostic performance of radiologists with different experience levels in interpreting PAS-related MRI findings in correlation with pathologic and surgical outcomes.

METHODS AND MATERIALS

This retrospective, multicenter, observational study included 60 women who underwent MRI for placental assessment and was conducted between 2016 and 2020 in a public university hospital and private hospital, both with an AIP-specialized multidisciplinary team.

Patient selection

Pregnant females whose ultrasound results indicated a suspicion of PAS were referred to our tertiary-care centers for an MRI evaluation for placental invasion during the third trimester of pregnancy.

The exclusion criterion was the absence of a surgical impression indicative of AIP.

MRI protocol

MRI was performed using a 1.5 T magnet (Magnetom Aera, Siemens Healthcare, Erlangen, Germany or Philips Achieva, Philips Healthcare, Best, The Netherlands).

Both hospitals used similar MRI protocols including multiplanar two-dimensional (2D) T_2-weighted (T2W) sequences [HASTE: half-Fourier single-shot turbo spin echo (TSE)] involving true fast imaging with steady-state precession in the axial, sagittal, and coronal planes of the uterus (axial oblique plane obtained perpendicular to the placenta-myometrium interface) and a T_1-weighted (T1W) TSE sequence with fat suppression in the axial plane. Additional scans of the placenta previa were performed with high-resolution axial and sagittal T2W non-fat-suppressed sequences for better visualizing the placental-uterine-bladder interface. Diffusion-weighted imaging (DWI) in the axial plane was also performed. Images were acquired at a slice thickness of 3 or 4 mm. All the evaluations were performed using a pelvic-phased array coil. Each patient was instructed not to empty her bladder before the examination, and i.v. gadolinium was not administered.

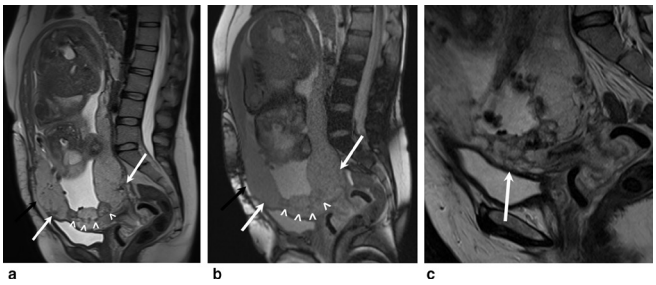
Image analysis

Anonymized images were stored in a Digital Imaging and Communications in Medicine (DICOM) viewer. MRI examinations were performed by four abdominopelvic radiologists with different experience levels: (1) a senior radiologist (practical abdominopelvic and placental MRI experience >7 years), (2) a junior radiologist (practical abdominopelvic and placental MRI experience <3 years), (3) a senior radiologist (practical abdominopelvic MRI experience >7 years but no placental MRI experience), and (4) a junior radiologist (practical abdominopelvic MRI experience <3 years but no placental MRI experience). All four radiologists interpreted the MRI findings following the same evaluation sequence (examinations were numbered from 1 to 60). The estimated time spent on the interpretations in each case did not exceed 30 min. The examiners were blinded to the ultrasound diagnosis, surgical and histopathological findings, and patient clinical data. The radiologists filled in a form with the described signs of placental accretism by MRI.

In all the MRI examinations, PAS-related imaging signs were evaluated, as placental signal intensity (homogeneous or heterogeneous), thickness (regular or irregular/lobulated contours), T2-dark intraplacental bands (yes/no), abnormal intraplacental vascularity (yes/no), abnormal placental bed vascularization(yes/no), retroplacental T2-hypointense line loss (yes/no), myometrial thinning (yes/no), placental/uterine bulge (yes/no), and bladder wall interruption (yes/no). The radiologist made a binary decision regarding the presence or absence of PAS and placenta accreta/increta or percreta.

Other placental characteristics, including the presence of placenta previa (yes/no) and intraplacental hemorrhaging (yes/no), were also evaluated.

Figure 1. 37-year-old gravida 3, para two female who had undergone two prior cesarean deliveries. Sagittal T_2-weighted (a) image showing placenta previa and T2 hypointense intraplacental flow voids (white arrows), which appear hyperintense on the corresponding steady-state free precession (b) image. In the same patient, both the sagittal (a) and (b) images demonstrate the characteristic hypointensity of intraplacental thick T2 dark bands (arrowheads) and myometrial thinning (black arrow). High-resolution sagittal T_2-weighted nonfat-suppressed (c) image showing the preservation (white arrow) of the normal hypointense maternal bladder wall.



As per the International Federation of Gynecology and Obstetrics' clinical grading system, in females not undergoing hysterectomy, the presence of PAS was defined by the surgical impression of placental invasion. The absence of PAS was defined as complete placental separation.[3] In females undergoing hysterectomy, following uterine specimen assessments, the presence of PAS was defined based on surgical impressions and pathologic outcomes. If a single patient had different degrees of placental invasion, the case was labeled according to the maximum depth of placental invasion.[14]

PAS-related MRI parameters

On MRI, placental texture is categorized as homogeneous or heterogeneous on T1W and T2W images.[10,15,16]

T2-dark bands are one or more hypointense areas on T2W images, which are frequently in contact with the maternal placental surface.[17–20]

Abnormal placental vascularity involves tortuous and dilated intraplacental vessels with calibers > 0.6 cm, usually located next to dark intraplacental bands on T2W images.[16]

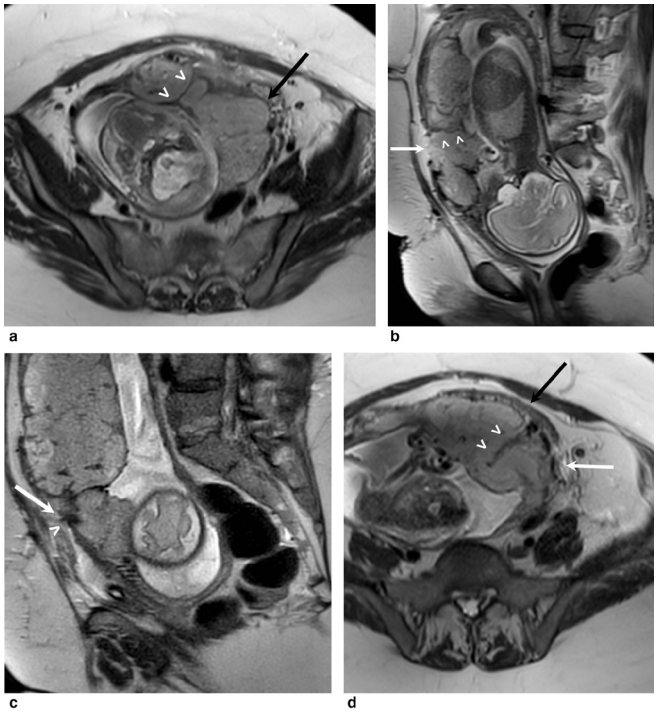
Abnormal placental bed vascularization is characterized by prominent disrupted placental bed vessels, sometimes accompanied by extensive neovascularization in adjacent organs.[10],Figure 1

Loss of the T2 hypointense interface is defined as the loss of a thin dark line on T2W images behind the placental bed.[21,22]

Myometrial thinning is defined as a focal thinning (<1 mm or even invisible) of the myometrium over the placenta.[11,23],Figure 2

Placental bulge is characterized by a distorted uterine outline caused by an abnormal outward bulge of placental tissue.[9,11,24],Figure 3

Figure 2. 41-year-old gravida 4, para three female who had undergone two prior cesarean deliveries. All the images were captured using T_2-weighted non-fat-suppressed sequences. (a) Axial image showing large placental and uterine bulge (black arrow), placental heterogeneous, and low-attenuation T2 linear bands (arrowheads). (b) Sagittal image showing loss of T2 hypointense interface with myometrial thinning (white arrow) and abnormal intraplacental vascularity (arrowheads). (c) High-resolution sagittal image showing maternal bladder involvement characterized by disruption (arrowhead) of the normal hypointense bladder wall consistent with extrauterine placental tissue involving the bladder wall. In this example, bladder tenting (white arrow) is also present, which is associated with bladder invasion. (d) Axial image showing abnormal intraplacental vascularity (arrowheads), myometrial thinning (white arrow), and placental bulge (black arrow).



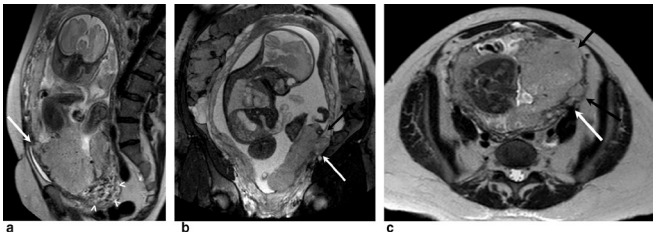
Bladder wall interruption is a disruption of the normal hypointense bladder wall on T2W images, sometimes accompanied by placental tissue protruding into the bladder lumen.[18,21],Figure 4

In placenta previa, the placental edge covers the internal cervical os. In the present study, the presence or absence of placenta previa was based on radiologist consensus.[25]

Statistical analysis

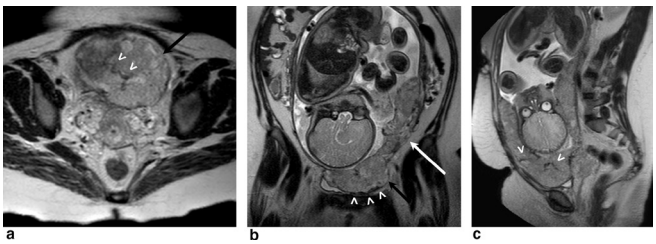
The normality of variables was assessed using the Kolmogorov test. Quantitative variables were described as means and standard deviations (SD). Obtained values were compared using Student's t-test. Categorical data were expressed as frequencies and percentages. Pearson's chi-square test was used to assess relationships between the categorical variables; subsequently, standardized adjusted residuals were used to detect categories with greater than expected frequencies.

Figure 3. 44-year-old gravida 3, para two female who had undergone two prior cesarean deliveries. Sagittal T_2-weighted (a) image showing placenta previa and subplacental hypervascularity of the placental bed characterized by prominent vessels (arrowheads) in the placental bed with disruption of the uteroplacental interface. In this image, maternal bladder involvement is also present (white arrow). Coronal steady-state free precession (b) and axial T_2-weighted (c) MR images showing placental and uterine bulge (black arrows) with an undefined left external iliac vein and contact with the left external iliac artery (white arrows); these findings are consistent with percreta placental invasion confirmed in patients with histories of caesarean sections.



Simple κ statistics were calculated to determine the agreement level among the radiologists regarding PAS and placenta percreta diagnoses and their agreement level regarding the surgical impression and/or pathologic confirmation of invasion for PAS and placenta percreta diagnoses. The κ values were interpreted as follows: slight, 0.00–0.20; fair, 0.21–0.40; moderate, 0.41–0.60; substantial, 0.61–0.80; and almost perfect, 0.81–1.00. The diagnostic performance (sensitivity, specificity, accuracy, and positive and negative predictive values) was calculated with 95% confidence intervals (CI).Statistical significance was set at $p < 0.05$. Statistical analyses were performed using SPSS, v.20.0, for Windows (SPSS Inc.; Chicago, IL, USA).

Figure 4. 40-year-old gravida 3, para two female who had undergone one prior cesarean delivery. All the images were captured using T_2-weighted non-fat-suppressed sequences. Sagittal T_2-weighted MR (a) image showing large placental and uterine bulge (black arrows) and abnormal intraplacental vascularity (arrowheads). (b) Coronal T_2-weighted image showing loss of T2 hypointense interface with myometrial thinning (white arrow), uterine bulge, and disruption of the normal hypointense bladder wall (arrowheads); these findings are consistent with percreta placenta. (c) Sagittal T_2-weighted non-fat-suppressed image showing placenta previa and abnormal intraplacental vascularity (arrowheads).



RESULTS

Patient characteristics

During the study period, 68 women underwent MRI for suspected placental invasion. The final study sample consisted of 60 patients. The exclusion criterion was the absence of a surgical impression indicative of AIP. Patient demographic and clinical characteristics are presented in Table 1. A definitive diagnosis of placental implantation disorder was established in 46 women. A statistically significant difference in maternal age was observed between the groups with and without PAS. The maternal age (mean ± SD) in the group without PAS was 33.0 ± 5.0, whereas that in the group with PAS was 36.0 ± 4.3 ($p = 0.013$). No significant differences were observed in the gestational age at the time of MRI, number of previous pregnancies and cesarean deliveries, or previous uterine surgery, such as curettage, between the groups (Table 1).

Placental characteristics on MRI

Placenta previa was reported in three (21.4%) patients without PAS and 22 (47.8%) patients with PAS ($p = 0.149$). Intraplacental bleeding and extraplacental bleeding were identified in one (7.1%) and two (14.3%) patients without PAS and in seven (15.2%) and 19 (41.3%) patients with PAS, respectively ($p = 0.070$).

Overall performance on MRI

Table 2 presents the distribution of accuracy (for PAS and placenta percreta), sensitivity, specificity, negative-predictive value (NPV), and positive-predictive value (PPV) corresponding to the PAS disorder diagnoses of each radiologist. These parameters were analyzed in the first and last 30 cases, and overall performance was analyzed in 60 cases.

The κ values for the agreement among the interpreters regarding a definitive diagnosis of placental implantation disorder were as follows: radiologist 1, 0.67 (substantial) ($p < 0.001$); radiologist 2, 0.38 (fair) ($p = 0.001$); radiologist 3, 0.40 (fair) ($p = 0.001$); and radiologist 4, 0.43 (moderate) ($p = 0.001$) (Table 3). The κ values for the interobserver agreement regarding a definitive placenta percreta diagnosis were as follows: radiologist 1, 0.87 (almost perfect) ($p < 0.001$); radiologist 2, 0.63 (substantial) ($p < 0.001$); radiologist 3, 0.57 (moderate) ($p < 0.001$); and radiologist 4, 0.62 (substantial) ($p < 0.001$).(Figure 5)

The κ values for the agreement regarding PAS diagnoses between radiologist one and the other radiologists were as follows: radiologist 2, 0.61(substantial) ($p < 0.001$); radiologist 3, 0.34 (fair) ($p = 0.003$); and radiologist 4, and 0.46 (moderate) ($p < 0.001$). The agreement regarding placenta percreta diagnoses between radiologist one and the other radiologists was as follows: radiologist 2, 0.59 (moderate) ($p < 0.001$); radiologist 3, 0.52 (moderate) ($p < 0.001$); and radiologist 4, 0.49 (moderate) ($p < 0.001$).[26]

Table 4 presents diagnostic accuracy based on the opinion of each radiologist with different experience levels in regard to the most widely used MRI parameters for PAS diagnoses.

Table 1. Demographic and clinical characteristics of females with and without a diagnosis of PAS disorder

Characteristic	PAS absent (n = 14)	PAS present (n = 46)	p
Maternal age (y), mean ± SD	33 ± 5.0	36.0 ± 4.3	0.013
Gestational age at time of MRI (wk), mean ± SD	30.9 ± 2.4	31.8 ± 2.6	0.234
Number of previous pregnancies:			0.972
1	1 (7.1%)	4 (8.7%)	
2	4 (28.6%)	12 (26.1%)	
≥3	9 (64.3%)	30 (65.2%)	
Number of prior cesarean deliveries:			0.828
0	4 (28.6%)	15 (32.6%)	
1	5 (35.7%)	15 (32.6%)	
2	2 (14.3%)	10 (21.7%)	
≥3	3 (21.4%)	6 (13.0%)	
Previous uterine surgery:			
Yes	2 (14.3%)	16 (34.8%)	0.192

PAS, Placenta accreta spectrum; SD, Standard deviation.

DISCUSSION

The study results revealed that there was an association between the radiologists' previous experience in interpreting PAS-related MRI findings and their diagnostic performance. Prior abdominopelvic MRI experience without specific placenta accreta spectrum-related MRI experience had no effect on diagnostic performance.

Overall, the most experienced radiologist had the highest sensitivity (100%; 95% CI, 92.3–100%) and NPV (100%; 95% CI, 63.1–100%) in PAS diagnoses; however, specificity and PPV were independent of experience. The most experienced radiologist demonstrated the highest accuracy in diagnosing AIP (90%; 95% CI, 79.5–96.2%) and placenta percreta (95%;95% CI, 86.1–99.0%).

While designing the study, we hypothesized that there would be a significant intra observer improvement in diagnostic performance throughout the assessments, at least in the case of the most inexperienced interpreters. However, on comparing the first 30 to the last 30 cases, no improvements were observed in the performances of any of the four interpreters.

There was a strong association between accurately confirming invasion and the highest experience level.

These results suggest that experience plays a significant role in accurately interpreting PAS-related MRI findings. The present study highlights the fact that the association between the radiologist's expertise and definitive placenta percreta diagnoses is significantly affected by overall experience, as demonstrated by the almost perfect κ value achieved by the senior radiologist (p < 0.001). More importantly, the diagnostic agreement was not affected by previous abdominopelvic MRI experience without specific placental MRI experience. Silver et al[27] reinforced that pelvic imaging-related expertise and experience are paramount and that knowledge and experience regarding antenatal placenta accreta diagnoses are more important than those in the field in which one subspecializes (*e.g.* maternal-fetal medicine or radiology).

To our knowledge, this retrospective study is the first in which the correlation between diagnostic performance in PAS and abdominopelvic MRI experience with and without specific experience in MRI for placental disorders was investigated in senior radiologists. In previous studies, radiologist's performances were compared, and the years of experience were considered; however, previous experience in interpreting PAS-related MRI was not described.

Our study demonstrated similar agreement levels regarding PAS diagnoses between a radiologist with practical MRI experience for placental disorders (<3 years) (κ value,0.38, p = 0.001) and radiologists without this specific experience (κ values,0.40, p = 0.001;0.43, p = 0.001), suggesting the need for higher experience levels in order to achieve greater agreement in diagnosing placental disorders on MRI. We found greater interobserver agreement between senior and junior radiologists with previous MRI experience in placental disorders compared to between the senior radiologist and junior radiologist without experience in interpreting MRI findings indicative of placental disorders, not only in accretism diagnoses but also in placenta percreta detection, suggesting that specific MRI experience in placental disorders can aidin accurately interpreting MR images.

MRI, a noninvasive and reliable modality for diagnosis and therapeutic planning in PAS, facilitates excellent interobserver variability in detecting the presence and depth of placental invasion.[28] However, interpreting MRI findings is considered challenging even for the most experienced radiologists and may be influenced by image interpretation-related skills.[11,18,29–31]

Table 2. Performance of radiologists in interpreting MRI findings related to PAS disorders

Diagnostic Performance Value	First 30 cases	Last 30 cases	All 60 cases
Sensitivity (%)			
Radiologist 1	100% (CI 83.9–100%)	100% (CI 88.7–100%)	100% (CI 92.3–100%)
Radiologist 2	100% (CI 83.9–100%)	92% (CI 74.0–99.0%)	95.7% (CI 85.2–99.5%)
Radiologist 3	85.7% (CI 63.7–97%)	76% (CI 54.9–90.6%)	80.4% (CI 66.1–90.6%)
Radiologist 4	85.7% (CI 63.7–97%)	80% (CI 59.3–93.2%)	82.6 (CI 68.6–92.2%)
Specificity (%)			
Radiologist 1	66.7% (CI 29.9–92.5%)	40% (CI 5.3–85.3%)	57.1% (CI 28.9–82.3%)
Radiologist 2	33.3 (CI 7.5–70.1%)	40% (CI 5.3–85.3%)	35.7% (CI 12.8–64.9%)
Radiologist 3	66.7% (CI 29.9–92.5%)	60% (CI 14.7–94.7%)	64.3% (CI 35.1–87.2%)
Radiologist 4	66.7% (CI 29.9–92.5%)	60% (CI 14.7–94.7%)	64.3% (CI 35.1–87.2%)
PPV (%)			
Radiologist 1	87.5% (CI 67.6–97.3%)	89.3% (CI 71.8–97.7%)	88.5% (CI 76.6–95.7%)
Radiologist 2	77.8% (CI 57.7–91.4%)	88.5% (CI 69.9–97.6%)	83.0% (CI 70.2–91.9%)
Radiologist 3	85.7% (CI 63.7–97%)	90.5% (CI 69.6–98.8%)	88.1% (CI 74.4–96.0%)
Radiologist 4	85.7% (CI 63.7–97%)	90.9% (CI 70.8–98.9%)	88.4% (CI 74.9–96.1%)
NPV (%)			
Radiologist 1	100% (CI 54.1–100%)	100% (CI 15.8–100%)	100% (CI 63.1–100%)
Radiologist 2	100% (CI 29.2–100%)	50% (CI 6.8–93.2%)	71.4% (CI 29.0–96.3%)
Radiologist 3	66.7% (CI 29.9–92.5%)	33.3% (CI 7.5–70.1%)	50.0% (CI 26.0–74.0%)
Radiologist 4	66.7% (CI 29.9–92.5%)	37.5% (CI 8.5–75.5%)	52.9% (CI 27.8–77.0%)
Accuracy PAS (%)			
Radiologist 1	90% (CI 73.5–97.9%)	90.0% (CI 73.5–97.9%)	90% (CI 79.5–96.2%)
Radiologist 2	80% (CI 61.4–92.3%)	83.3% (CI 65.3–94.4%)	81.7% (CI 70.0–90.5%)
Radiologist 3	80% (CI 61.4–92.3%)	73.3% (CI 54.1–87.7%)	76.7% (CI 64.0–86.6%)
Radiologist 4	80% (CI 61.4–92.3%)	76.7% (CI 57.7–90.1%)	78.3% (CI 65.8–87.9%)
Accuracy Percreta (%)			
Radiologist 1	93.3% (CI 77.9–99.2%)	96.7% (CI 82.8–99.9%)	95% (CI 86.1–99.0%)
Radiologist 2	76.7% (CI 57.7–90.1%)	90.0% (CI 73.5–97.9%)	83.3% (CI 71.5–91.7%)
Radiologist 3	80.0% (CI 61.4–92.3%)	86.7% (CI 69.3–96.2%)	83.3% (CI 71.5–91.7%)
Radiologist 4	86.7% (CI 69.3–96.2%)	83.3% (CI 65.3–94.4%)	85% (CI 73.4–92.9%)

PAS, Placenta accreta spectrum.

Sensitivity % (95% confidence interval (CI)), specificity % (95% CI),PPV: positive predictive value (95% CI), NPV: negative predictive value (95% CI), and accuracy % foroutcome of placental adhesion disorder. Accuracy% for the outcome of placenta percreta.Radiologist 1:practical experience in abdominopelvic and placental MRI > 7 years, radiologist 2: practical experiencein abdominopelvic and placental MRI < 3 years, radiologist 3: practical experience in abdominopelvicMRI > 7 yearsbut no experience in placental MRI, radiologist 4: practical experience in abdominopelvicMRI < 3 years but no experience in placental MRI.

The IS-AIP considers radiologists with AIP-related experience as members of a multidisciplinary team in a center of excellence.[2] However, in the literature, there are limited data regarding the definition of an experienced radiologist and whether practical abdominal MRI experience without specific experience in interpreting MR images related to placental disorders can help in the radiologist's diagnostic performance. Alamo et al showed that the diagnostic value of MRI in placental invasion significantly depends on radiologists' experience.[13] In their study involving 25 pregnant females, the senior radiologist with practical abdominal MRI experience (>5 years) detected placental invasion and depth of infiltration with significantly higher diagnostic certitude than juniors with practical abdominal MRI experience(<3 years)(p = 0.0002 and p = 0.0282, respectively).[13]

In an attempt to improve diagnostic performance on MRI, the Society of Abdominal Radiology and European Society of Urogenital Radiology proposed strategies to standardize PAS-related image acquisition, interpretation, and reporting on MRI, based on expert opinions. Here, too, the radiologist's experience

Table 3. Radiologists' agreement regarding definitive diagnoses of placental adhesion disorder and placenta percreta

Diagnosis	κ	*p*
PAS		
Radiologist 1	0.67	<0.001
Radiologist 2	0.38	0.001
Radiologist 3	0.40	0.001
Radiologist 4	0.43	0.001
Placenta percreta		
Radiologist 1	0.87	<0.001
Radiologist 2	0.63	<0.001
Radiologist 3	0.57	<0.001
Radiologist 4	0.62	<0.001

PAS, Placenta accreta spectrum.
Radiologist 1: practical experience in abdominopelvic and placentalMRI > 7 years, radiologist 2: practical experience in abdominopelvic and placental MRI < 3 years,radiologist 3: practical experience in abdominopelvic MRI > 7 yearsbut no experience in placental MRI,radiologist 4: practical experience in abdominopelvic MRI < 3 years but no experience in placental MRI.

is considered important for diagnosis and therapeutic planning.[1] Priyanka Jha et al.'s consensus statement reveals accuracy of 70% (95% CI, 65–79%), 90% (95% CI, 65–93%), 90% (95% CI, 84–96%), and 70% (95% CI, 58–81%) corresponding to abnormal intraplacental vascularity, T2-dark bands, T2 hypointense interface loss, and placental heterogeneity, respectively.[1] In our study, the most experienced radiologist in placental MRI corroborated these data, demonstrating accuracy of 83.3% (95% CI, 71.5–91.7%), 81.7% (95% CI, 69.6–90.5%), 81.7% (95% CI, 69.6–90.5%), and 85.0% (95% CI, 73.4–92.9%), respectively, for the above-mentioned signs.

Priyanka Jha et al. demonstrated higher accuracy of 90% (95% CI, 87–95%) for "myometrial thinning," one compared to our most experienced radiologist who demonstrated accuracy of 61.7%

Figure 5. 39-year-old gravida 2, para one female who had undergone one prior cesarean delivery and who presented with findings that lead to the suspicion of abnormal invasive placenta on a prior MRI examination. (a) Transoperative image showing a median incision and direct visualization of the placenta. (b) Photographs of gross specimens of the uterus after cesarean hysterectomy showing the placenta invading beyond the serosa of the right lower uterine segment (black arrow), consistent with placenta percreta.

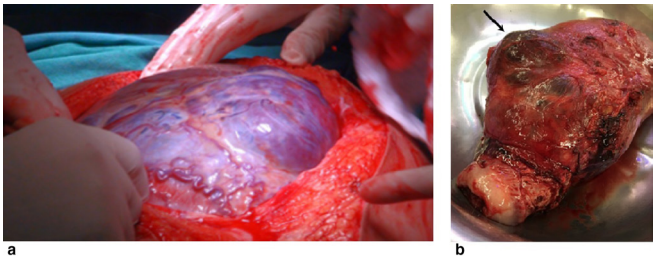

a b

Table 4. Diagnostic accuracy corresponding to each criterion related to placental adhesion disorder based on the experience of the radiologists

MRI parameters	Radiologist 1 Accuracy	Radiologist 2 Accuracy	Radiologist 3 Accuracy	Radiologist 4 Accuracy
Placental heterogeneity	85.0% (CI 73.4–92.9%)	75.0% (CI 62.1–85.3%)	73.3% (CI 60.3–83.9%)	60.0% (CI 46.5–72.4%)
Thickness	65.9% (CI 51.6–76.9%)	70.0% (CI 56.8–81.2%)	71.7% (CI 58.6–82.6%)	51.7% (CI 38.4–64.8%)
T2-dark bands	81.7% (CI 69.6–90.5%)	75.0% (CI 62.1–85.3%)	71.7% (CI 58.6–82.6%)	65.0% (CI 51.6–76.9%)
Abnormal intraplacental vascularity	83.3% (CI 71.5–91.7%)	76.7% (CI 64.0–86.6%)	78.3% (CI 65.8–87.9%)	70.0% (CI 56.8–81.2%)
Abnormal vascularization of the placental bed	75,.% (CI 62.1–85.3%)	66.7% (CI 53.3–78.3%)	73.3% (CI 60.3–83.9%)	58.3% (CI 44.9–70.9%)
Loss of T2 hypointense interface	81.7% (CI 69.6–90.5%)	88.3% (CI 65.8–87.9%)	58.3% (CI 44.9–70.9%)	60.0% (CI 46.5–72.4%)
Myometrial thinning	61.7% (CI 48.2–73.9%)	66.7% (CI 53.3–78.3%)	75.0% (CI 62.1–85.3%)	46.7% (CI 33.7–60.0%)
Placental bulge	90.0% (CI 79.5–96.2%)[a]	70.0% (CI 56.8–81.2%)[a]	83.3% (CI 71.5–91.7%)[a]	88.3% (CI 77.4–95.2%)[a]
Bladder wall interruption	90.0% (CI 79.5–96.2%)[a]	81.7% (CI 69.6–90.5%)[a]	83.3% (CI 71.5–91.7%)[a]	85.0% (CI 73.4–92.9%)[a]

Accuracy %: (95% confidence interval (CI)) for each predictor variable for each radiologist for the outcome of placental adhesion disorder.
[a]Outcome of placenta percreta. Radiologist 1: practical experience in abdominopelvic and placental MRI > 7 years, radiologist 2: practical experience in abdominopelvic and placental MRI < 3 years, radiologist 3: practical experience in abdominopelvic MRI > 7 years but no experience in placental MRI, radiologist 4: practical experience in abdominopelvic MRI < 3 years but no experience in placental MRI.

(95% CI, 48.2–73.9%) (Table 4). Additionally, the most experienced radiologist in placental MRI demonstrated high placenta percreta diagnostic accuracy of 90% (95% CI, 79.5–96.2%) on detecting "placental bulge" and "bladder wall interruption."

Our study results indicating a statistically significant difference in mean maternal age between the groups with and without PAS (36.0 ± 4.3 *vs* 32.6 ± 4.8;$p = 0.013$) confirm those in the literature.

Contrary to previous studies, we did not find statistically significant differences in the number of previous cesarean sections and pregnancies, history of uterine surgery, and presence of placenta previa between the groups.[27]

This study had some limitations. First, the number of participants, although significant in the context of AIP and in comparison with that in previous studies, may be insufficient to generate statistically significant differences from a statistical point of view. The interobserver differences would be more pronounced in a larger sample. Second, there was disagreement regarding surgical and histopathological diagnoses in a small sample (six females). Here, the highest degree of invasion was considered indicative of definitive diagnoses, as described in surgical case reports. Previous studies have shown that surgical diagnoses may be preferable to pathological diagnoses.[32] Finally, associations between ultrasound and MRI were not investigated because the interpreters were blinded to clinical data. Studies suggest that these methods may be complementary in equivocal PAS cases.[33–35]

In conclusion, based on our results, previous experience in interpreting PAS-related MRI findings plays a significant role in diagnostic accuracy. Previous experience in abdominopelvic MRI without specific experience in PAS-related MRI does not improve diagnostic performance.

KEY RESULTS

- The kappa values for the interobserver agreement in placenta accreta spectrum diagnoses were 0.67 (substantial) for the senior radiologist ($p < 0.001$) and 0.38 (fair), 0.40 (fair), and 0.43 (moderate) for the others ($p = 0.001$).
- The most experienced radiologist had the highest sensitivity (100%, 95% confidence interval (CI): 92.3–100%) and negative-predictive value (0% and 100%, 95% CI: 63.1–100%) in placenta accreta spectrum.
- There is a strong association between definitive diagnoses and the highest experience level.

SUMMARY STATEMENT

Previous experience in placenta accreta spectrum disorder-related MRI evaluations is significantly associated with diagnostic accuracy on MRI; previous abdominopelvic MRI experience without placental MRI experience does not improve diagnostic accuracy.

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