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ULTRASOUND VS. MAGNETIC RESONANCE IMAGING
IN THE DIAGNOSIS OF PLACENTA ACCRETA SPECTRUM

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Abstract

PAS (Placenta Accreta Spectrum) is a rare, multifactorial, life-threatening condition for both the mother and the fetus, posing a diagnostic challenge for both expert and non-expert sonographers during the clinical monitoring of pregnancy. The aim of this work is to assess the prenatal diagnostic predictability of placenta accreta spectrum comparing two methods: ultrasound and magnetic resonance imaging. A prospective comparison was done over a 4-year period (2019–2022) between US and MRI diagnostic recognitions of PAS. Thirty-four cases prenatally were diagnosed by US and confirmed pathohistologically with complete agreement. Comparative diagnostic recognition was performed in 74 cases suspected for placenta praevia accreta by US, in 35 cases PAS were found, and 39 were excluded as normal placenta praevia. In 41 of all 74 cases, MRI was additionally performed. The US has done by one expert and the following markers for PAS were examined: loss of clear space, abnormal lacunae, subplacental hypervascularity, and bridging vessels. MRI diagnosis following standard protocols from more than one expert was made. The presented observation period was part of an 11-year prospective study (2012–2023) covering 61 cases of clinically and pathohistologically confirmed PAS. The results showed that MRI has a recognizability rate of 67.62% compared to ultrasound, which showed a 97.14% coincidence. The US methodology has significance detecting PAS and was primarily performed by one expert ($p < 0.001$). MRI showed the same statistical significance in the diagnosis of placenta praevia and accreta ($p < 0.001$). The comparative results for the diagnosis of placenta accreta were

as follows: 90.00% sensitivity, 97.06% specificity, Positive Predictive Value – 96.43%, Negative Predictive Value – 91.67% for ultrasound examination. For MRI we found similar sensitivity 97.62%, but low specificity, positive predictive value and negative predictive value (5.36%, 69.49%, 50.00%, respectively). Ultrasound is a superior, accessible method for diagnosis of PAS. MRI is an additional method in the diagnosis of PAS and should be used selectively. Both methods have comparable sensitivity.

Key words: placenta accreta spectrum (placenta accreta), placenta praevia, magnetic resonance imaging

Introduction. Systematic reviews and meta-analyses summarized by the World Federation of Obstetricians and Gynecologists and the American College of Obstetricians and Gynecologists have confirmed that antenatal diagnosis of placenta accreta spectrum (PAS) reduces the frequency of perioperative complications, particularly the risk of surgical bleeding. Diagnosis remains a challenge even today, including for experts in ultrasonography. However, recent population studies showed that PAS remains undetected before birth in up to one-third of cases. Antenatal diagnosis has a sensitivity and specificity close to 90% in a series of studies by experts and correspondingly drops to around 50% when diagnosed by non-experts [1,2]. Diversity in diagnostic criteria and lack of correlation with the final diagnosis led to the establishment and systematization of commonly accepted standard markers for detailed ultrasound examination of PAS in high-risk groups – patients with one or more previous Caesarean sections and placenta praevia. In 2016, the Association proposed ten grayscale and Doppler criteria concerning the lower uterine segment and the uterine scar, adding another seven related to changes in the cervix, retro-placental obliteration, and parametrial hypervascularization [3]. Screening and prenatal diagnosis of the placenta accreta spectrum are primarily credited to ultrasound, while MRI is an additional expensive method used mainly to assess the depth of placental invasion and parametrial involvement.

Comparative studies between the two diagnostic methods are based on the significance and accuracy of the diagnostic markers used in predicting placenta praevia and placenta accreta. From a diagnostic-epidemiological perspective, FIGO accepts that the diagnosis is most likely in high-risk groups, where the combination of the two main risk factors doubles and triples the risk of placenta accreta. Magnetic resonance imaging (MRI) is a newer method in obstetric practice for diagnosing invasive placenta, and its diagnostic precision is influenced by the experience of experts, considering that the clinical condition is rare. Expert studies in the last decade provide data on increasing frequency of PAS up to 50%, ending with Caesarean hysterectomy in 90% of the cases [4]. Currently, the society of radiologists agrees on standardized topographic markers and definitive diagnosis of placenta accreta and the degree of microinvasion to determine the surgical approach and improve clinical outcomes. It is not disputed that ultrasound is the primary imaging method [5].

It is essential to evaluate the outcome of surgical treatment, making the pathologist a key figure in the final diagnosis, but some cases of PAS are not confirmed pathohistologically in 18–20% of cases [6]. Studies showed, that placenta accreta vera represents about 60% of PAS, while increta and percreta invasions represent 16% and 22% of PAS [7].

The objective of this study is to compare diagnostic discrepancies and trends in antenatal predictive accuracy for the placenta accreta spectrum between two methods – ultrasound and MRI.

Materials and methods. We presented a representative sample from an 11-year prospective observation (2012–2023) predominantly focused on antenatal ultrasound diagnosis and clinical outcomes of PAS, also known as placenta accreta, covering a 4-year period from 2019 to 2022, when we started using MRI. The aim was to compare the diagnostic accuracy for PAS between ultrasound and MRI in gestational period 26–32 weeks. Non-experts predominantly sent 74 cases of suspected placenta praevia and accreta for second opinion and hospitalisation in University Hospital “Maichin Dom”, Sofia. In 35 cases placenta praevia, previous CS with ultrasound markers of placenta accreta were found. The ultrasound findings were compared with 41 cases where additional MRI was performed. From all patients, 39 cases were excluded as a normal placenta praevia. In 34 cases, placenta accreta was confirmed pathohistologically after Caesarean hysterectomy, one case was not confirmed. The ultrasound methodology, transabdominal and transvaginal access, were based on criteria established by the Association of Abnormally Invasive Placenta since 2016 with the highest sensitivity in the lower uterine segment for high-risk patients with at least one previous Caesarean section and placenta praevia: bridging vessels, loss of clear space, abnormal lacunas, subplacental hypervascularity; intraoperative findings include placental bulge and neovascularity, calculated with high sensitivity and specificity of the used ultrasound markers ranging from 88% to 100%, performed by one expert. MRI findings followed a standard protocol, evaluated by two to three experts.

All investigated patients for 11-year period were compared by patients' characteristics between two groups: 135 cases with normal placentas and 54 cases of histologically confirmed placenta accreta. The main risk factors for placenta accreta included: one or more previous Caesarean section, placenta praevia or low-lying placenta at less than 2 cm from internal os, mean maternal age over 35 years.

Data were processed statistically through systematic 4-year analysis, diagnostic-prognostic methods presented in tabular form. Mean values, standard deviations, statistical significance at $p < 0.05$, and applicable tests such as t -test and Fisher's test were calculated.

Results. The patients' characteristics showed a high predictive value for previous CS and for second risk factor placenta praevia or low-lying placenta ($p < 0.001$). Maternal age over 35, mean age over 34.6 and multiparity were additional risk factors. The results are presented in Table 1.

T a b l e 1
Patients' characteristics and risk factors

Characteristics and risk factors	Normal placenta	%	PAS	%	<i>p</i>
Number of patients	135		54		
Mean age	31.5		34.6		0.0212
Age over 35	25	18.5	24	44.4	0.000102
Primipara	36	26.7	4	7.4	0.00166233
Multipara	99	73.3	50	92.6	0.0000
Previous 1 Sc	70	51.9	42	77.8	0.0005
Previous 2 Sc	0	0.0	7	12.9	Na
Pl. praevia/low-lying placenta	7	5.2	35	64.8	0.000

From 74 cases referred for second opinion or diagnosed for the first time in the hospital, 39 were diagnosed as placenta praevia or low-lying placenta without US markers for PAS. Other 35 cases were diagnosed by US as PAS. We had histological confirmation in 34 cases of PAS. In 41 cases additional MRI was performed (Table 2).

T a b l e 2
Summarized cases of suspected PAS, placenta praevia, proved PAS, and MRI diagnosed

Year	Supposed Pl. praevia/PAS	Pl. praevia, Low lying placenta, without PAS	PAS histology	MRI diagnosis PAS
2019	21	12	10	10
2020	17	8	9	8
2021	20	11	10	20
2022	16	8	5	3
Total	74	39	34	41

Both methods showed high significance, while coincidence is higher in US – 97.14% vs. 67.62% in MRI ($p < 0.001$) (Table 3).

The comparative study between ultrasound and MRI showed 90% sensitivity of ultrasound and 97% sensitivity of MRI, a high specificity of 97% for ultrasound versus a low specificity for MRI of 5.2%. The positive and negative predictive values of ultrasound were 96% and 91%, versus 69% and 50%, respectively, for MRI. Ultrasound also showed 89% sensitivity in differentiating pl. praevia from pl. accreta with a high negative predictive value of 86%. MRI sensitivity was 56%. The two methods showed a comparative statistical significance in determining the diagnosis of placenta accreta (Table 4).

Discussion. The absence of ultrasound findings does not exclude the diagnosis of PAS, especially in the presence of major risk clinical factors. An expert

T a b l e 3

Comparison between two methods – ultrasound and magnetic resonance, for diagnosis of placenta accreta over a period of 4 years

		Placenta		<i>p</i>
		Pl. praevia and PAS	Pl. accreta histology	
		<i>n</i> = 74	<i>n</i> = 35	
US	Yes	35	34	0.000000807
	No	39	1	
MRI	Yes	41	23	0.00000575
	No	0	18	

T a b l e 4

Statistical correlations between US and MRI

	Sensitivity	Specificity	PPV	NPV
US – PAS	90.00	97.06	96.43	91.67
MRI – PAS	97.62	5.26	69.49	50.00
US – PAS/Pl. praevia	89.74	25.25	32.11	86.21
MRI – PAS/Pl. praevia	56.10	2.38	35.94	5.26

study on 3209 pregnant women presents the following results: ultrasonography has good diagnostic accuracy for identifying the depth of placental invasion with a sensitivity of 90.6% [8]. In a prediction model for placenta accreta the highest sensitivity was found for uterovesical hypervascularity, bladder wall disruptions, and the presence of lacunae as the most sensitive ultrasound markers for placenta accreta spectrum [9].

MRI changes the diagnosis of PAS in 1/3 of cases, and this is usually an incorrect diagnosis. MRI is a second-line diagnostic method for assessing the depth of invasion, particularly lateral extension, especially when the placenta is located posteriorly. For parametrial invasion, MRI has a greater technical capability for assessment, as well as in patients with high BMI. Expert evaluation of MRI makes it difficult to use due to the smaller number of qualified experts with less experience because of the rare finding. The technique is expensive and less accessible.

Magnetic resonance imaging (MRI) is increasingly used for antenatal detection of PAS in regions of interest where ultrasound encounters difficulties in diagnosis and is useful in assessing the depth of myometrial and parametrial invasion [2,10]. Prenatal MRI is found to be very accurate in identifying invasive placentation disorders, and both ultrasound and MRI have comparable predictive parameters. The depth of placental tissue extension through the uterine wall is

determined by the absence of decidua basalis, with the placenta attaching to the superficial myometrium and progressing deeper. The sensitivity and specificity of ultrasound range between 77–93% and 71–96%, respectively, and it remains the preferred method according to radiologists [11]. In a summary publication on Radiopedia, the ultrasound sensitivity for the placenta accreta spectrum is 90%, with a negative predictive value of 98%; magnetic resonance imaging is cited as a method to aid in diagnosis and minimize maternal and fetal complications; demonstrative findings include two phenomena: bulging and loss of the normal uterine contour [12]. Overall, it is unclear whether MRI improves the diagnosis of PAS beyond what can be achieved by trained ultrasound experts. MRI may be less operator-dependent, but its cost and limited access to equipment and expert radiologists make it impractical as a screening tool for PAS. The diagnostic value of both methods is that they have comparable accuracy in predicting placenta accreta; magnetic resonance imaging has an advantage in determining the extent and depth of invasion [13]. In more recent studies, MRI advantages are highlighted for delivery timing, surgical planning, and decision-making for patients requiring hysterectomy. The accuracy of MRI diagnosis is 65% [14]. Ultrasound is superior to MRI in detection of placenta accreta [15].

Our results were similar to those in the literature with coincidence of 97% using US and 67% with MRI. We have confirmed the two main risk factors for PAS: previous Caesarean section and placenta praevia.

A comparative study between ultrasound and magnetic resonance imaging found similar diagnostic significance and accuracy of both methods. Ultrasound has a higher detection rate in the initial diagnosis, while MRI is recommended in cases of diagnostic difficulties – posterior placenta, obesity, degree of invasion. The predictive value categorically depends on the experience and qualifications of the sonographer and radiologist [16].

An ultrasound scoring system for diagnosing PAS and predicting maternal and neonatal outcomes for PAS had a sensitivity of 100%, specificity of 89%, and accuracy of 92% [17].

Diagnostic accuracy in a comparative study between ultrasound and magnetic resonance imaging suggests that the presence of more than three ultrasound markers indicates a high probability of placenta accreta, with ultrasound sensitivity of 84% and specificity of 92%. The presence of more than three markers in magnetic resonance imaging is associated with a sensitivity of 92% and specificity of 61.5% for predicting PAS. MRI is not routinely recommended for all cases but is recommended as an additional diagnostic method [18].

Ultrasound remains the primary gold standard method for diagnosing PAS, confirming global experience. It has been proven to have the highest sensitivity and accuracy. Results show a correlation between the two markers and histopathological findings [19].

Conclusion. Based on sufficient ultrasound and clinical experience acquired through prospective observation over more than 11 years on the diagnosis and clinical outcomes of PAS, we recommend ultrasound examination by experts as the first-line diagnostic predictive method for placenta accreta. Magnetic resonance imaging is an additional diagnostic method and should be used with strict indications, in cases of diagnostic difficulties and for future surgical strategy. Both methods have similar sensitivity, with higher specificity, positive, and negative predictive values in favour of ultrasound.

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