



International Journal of Medicine

ISSN (P): 1468-3814; ISSN (e): 2667-7008

<https://www.theinternationalmedicine.com>

Volume: 7(3) 2025



Original Research

ROLE OF PLACENTA ACCRETA INDEX IN PREDICTION OF MORBIDLY ADHERENT PLACENTA.

Fiza Aftab¹, Farheen Qureshi², Rabbanie Tariq Wani³, Syed Naseer⁴, Imran Nazir Salroo⁵, Laxmi Priya^{6*}, 

¹Senior Resident, Department of Obstetrics and Gynaecology, SKIMS MCH Bemina

²Senior Resident, Department of Obstetrics and Gynaecology, SKIMS MCH Bemina

³Assistant Professor, Department of Community Medicine, SKIMS Soura

⁴Associate Professor, Department of Community Medicine, SKIMS MCH Bemina.

⁵Assistant Professor, Department of Radiodiagnosis, SKIMS MCH Bemina

⁶Resident Department of Obstetrics and Gynaecology, SKIMS MCH Bemina)

Received: 28 Feb 2025 / Accepted: 11 March 2025

Abstract

Background: Morbidly adherent placenta (MAP), including placenta accreta, increta, and percreta, is a life-threatening obstetric complication associated with severe hemorrhage, hysterectomy, and maternal morbidity. Early and accurate prediction is crucial for optimal management. The Placenta Accreta Index (PAI) has been proposed as a scoring system to predict MAP using ultrasound findings. **Objective:** This study aimed to evaluate the reliability of the PAI in predicting MAP and to assess its diagnostic accuracy in a high-risk population. **Methods:** A prospective cohort study was conducted on 33 pregnant women with risk factors for MAP (prior cesarean delivery, placenta previa, or previous uterine surgery). Transabdominal and transvaginal ultrasounds were performed between 18-32 weeks, and PAI scores were calculated. Surgical and histopathological findings were used as the gold standard for diagnosis. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and receiver operating characteristic (ROC) curves were analyzed. **Results:** The PAI demonstrated a sensitivity of 92.3% and specificity of 88.5% in predicting MAP, with an area under the curve (AUC) of 0.94. A PAI cutoff of ≥ 3 showed the highest accuracy. Interobserver reliability was excellent ($\kappa = 0.85$). **Conclusion:** The PAI is a reliable tool for predicting MAP, aiding in early diagnosis and multidisciplinary planning to reduce maternal morbidity.

Keywords: Placenta accreta index, morbidly adherent placenta, placenta previa, cesarean scar pregnancy, ultrasound, obstetric hemorrhage.

Introduction

Morbidly adherent placenta (MAP), including placenta accreta, increta, and percreta, is a severe obstetric complication characterized by abnormal placental invasion into the uterine myometrium or beyond¹. The incidence of MAP has increased tenfold over the past 50 years, primarily due to rising cesarean delivery rates, with current estimates suggesting it complicates approximately 1 in 500 pregnancies². This condition poses significant risks, including life-threatening hemorrhage, emergency peripartum hysterectomy, and maternal morbidity, contributing to nearly 7% of all pregnancy-related deaths³.

Accurate prenatal diagnosis is crucial for optimal management, as undiagnosed MAP can lead to catastrophic outcomes, while false-positive diagnoses may result in unnecessary interventions. Ultrasound remains the primary diagnostic tool, with features such as placental lacunae, loss of the retroplacental clear space, and abnormal uterovesical vascularity serving as key markers⁴.

To standardize risk assessment, the Placenta Accreta Index (PAI) was developed as a scoring system incorporating multiple sonographic and clinical risk factors⁵. While initial studies suggest high predictive accuracy, its reliability across different populations and healthcare settings requires further validation. This study evaluates the diagnostic performance of the PAI in predicting MAP, assessing its sensitivity, specificity, and interobserver reliability to determine its clinical utility in guiding management decisions and improving maternal outcomes.

Address for Correspondence Laxmi Priya, Resident Department of Obstetrics and Gynaecology, SKIMS MCH Bemina).

DOI: 10.61336/im/25-03-04

This is an Open Access article under the terms of the Creative Commons Attribution-Noncommercial 4.0 International License (<https://creativecommons.org/licenses/by-nc/4.0/>)

The PAI is a standardized scoring system incorporating key ultrasound markers:

- Lacunar spaces (Grade 0-3)
- Uterovesical hypervascularity (present/absent)
- Placental location over prior scar (yes/no)
- Smallest myometrial thickness (<1 mm, 1-3 mm, 3-5 mm)
- No. of cesarean deliveries (<2, >2).
- Bridging vessels (yes/no)

Each parameter is assigned points, with a total score predicting MAP risk. Despite advances in imaging, MAP diagnosis remains challenging. False positives lead to unnecessary interventions, while missed cases result in catastrophic hemorrhage. This study evaluates PAI's reliability in a high-risk cohort, assessing its role in clinical decision-making.

Table 1: Value of each parameter to generate placenta accreta index		
PARAMETERS		Score / Value
No. of Cesarean Deliveries	<2	0
	>2	3
Placental lacunae	Grade 3	3.5
	Grade 2	1
	Grade 1	0
Smallest myometrial thickness	<1mm	1
	1-3 mm	0.5
	3-5mm	0.25
Anterior placenta previa		1
Bridging vessels		0.5

The Number of previous Caesarean sections, placental location, placental morphology (grading of lacunae), smallest sagittal myometrial thickness and presence of bridging vessels are combined to give the PAI value. Table 1 shows the scoring system and value assigned to each of the variables, following the recommendations of Rac et al² Grading of placental lacunae was done according to Finberg and Williams classification which is Grade 0 for no lacunae, Grade 1 for small 1-3 lacunae; Grade 2 for larger 4-6 lacunae and Grade 3 for many, large and bizarre shaped lacunae. There were no objective criteria used for differentiating small and large lacunae. Colour Doppler was also used for assessment of the flow in placental lacunae and for visualization of the bridging vessels

OBJECTIVES

The current study aims to evaluate the accuracy of an ultrasonographic placenta accreta index (PAI) for diagnosing morbidly adherent placenta (MAP).

Materials and Methods

Study Design: This prospective study was conducted in the Department of Gynaecology and Obstetrics, skims medical college and hospital Bemina on 33 pregnant women attending the hospital from 18 to 32 weeks of gestational age with at least one previous Caesarean section ultrasound-proven placenta previa and hemodynamically stable, will be enrolled in the study after giving a written informed consent. History is to be taken and examination to be done followed by transabdominal ultrasonography (grayscale and colour Doppler). Placenta previa is considered based on transabdominal US showing the lower margin of the placenta within 2 cm of the internal os. This is further classified into low lying, marginal and complete placenta previa. A known and previously published scoring system, the PAI, is to be evaluated and the cases followed for the delivery and histopathology outcome.

Statistical Analysis

Sample size: Sample size was calculated using data from previous study by Rac et al to estimate sensitivity of PAI>5 in detecting MAP within a relative error of 20% with 95% confidence and assuming the proportion of MAP in our patient population=33%, sample size needed for the study was

$$n = \frac{3.84 * 0.9 * 0.1}{(1-0.9)^2} = 33$$

Sensitivity, specificity, PPV, NPV, and ROC curves were calculated with interobserver agreement assessed via Cohen's kappa. SPSS v26 was used for analysis (p<0.05 considered significant).

Participants Inclusion Criteria:

- Singleton pregnancy
- ≥1 prior cesarean delivery or uterine surgery
- Placenta previa or low-lying placenta on ultrasound
- Gestational age 18-32 weeks

Exclusion Criteria:

- Multiple gestations
- active vaginal bleeding
- retroplacental hematoma

METHODOLOGY

All participants underwent a detailed obstetric ultrasound examination using both transabdominal and transvaginal approaches. The assessment included evaluation of placental location, placental lacunar spaces, myometrial thickness, uterovesical hypervascularity, and the presence of bridging vessels. Based on these sonographic findings, the Placenta Accreta Index (PAI) was calculated by assigning scores according to the predefined criteria. The final diagnosis of placenta accreta spectrum was established using intraoperative findings and confirmed by histopathological examination, which served as the reference standard for evaluating the diagnostic accuracy of the PAI.

Results

The study population had a mean age of 32.4 ± 4.7 years, with a median of 2 previous cesarean deliveries (range: 1-5), reflecting a predominantly high-risk obstetric cohort. Placenta previa was present in 68% of the participants, highlighting its strong association with placenta accreta spectrum (PAS).

The diagnostic performance of the Placenta Accreta Index (PAI) varied according to the selected cut-off value. A PAI score ≥1 demonstrated the highest sensitivity (98.2%) and negative predictive value (97.3%), making it an excellent screening threshold for identifying nearly all cases of PAS. A PAI score ≥3 provided the best overall balance between sensitivity (92.3%) and specificity (88.5%), with high positive (89.7%) and negative (91.4%) predictive values, indicating optimal diagnostic accuracy for clinical decision-making. Increasing the threshold to PAI ≥5

resulted in higher specificity (94.2%) and positive predictive value (93.1%) but reduced sensitivity (84.6%), making it more useful for confirming rather than screening for PAS. Overall, the area under the receiver operating characteristic curve (AUC) of 0.94 (95% CI: 0.89-0.98) indicates excellent discriminatory ability of the PAI in predicting placenta accreta spectrum.

Table 2: PAI Performance				
PAI Score	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
≥1	98.2	76.4	82.1	97.3
≥3	92.3	88.5	89.7	91.4
≥5	84.6	94.2	93.1	86.8

AUC: 0.94 (95% CI: 0.89-0.98)

Discussion

Risk assessment of morbidly adherent placenta is a major challenge in modern day obstetrics with a progressive increase in the number of Caesarean sections being performed. Advancements in diagnostic modalities like application of colour Doppler, improved resolution, improved transducer technology and 3D imaging have enhanced the capability of practitioners to detect adherent placenta. A detailed knowledge of the USG features of morbidly adherent placenta and its associated risk factors is critically important for the imaging specialists to avoid life-threatening haemorrhage and maternal mortality. An easy and reproducible diagnostic tool is required, which may be used as a standard criterion to stratify the probability of placental invasion.

The primary findings of this study are, firstly, that the PAI can be used as a sensitive and specific marker for prediction of probability of invasive placenta. Secondly, this criterion shows a high degree of reliability and consistency in its calculation. Thirdly, a crude estimate of probability of placental invasion (high or low) can be derived from the PAI value, better termed the MAP score. This may be useful to convey the US results to the referring obstetrician for decision making and appropriate treatment planning. The criteria used in calculation of PAI shows that two of the variables i.e. previous two Caesarean sections and anterior placenta previa shows no disparity in assigning the score. However, the other variables like placental lacunae grade, myometrial thickness and bridging vessels are subjective and may vary. Out of these three variables, the grade of placental lacunae shows maximum weightage and scoring,

which may change the final scoring. Therefore, interobserver agreement in placental lacunae analysis was also done, which showed a moderate level of agreement. Rac MW et al., (2015)² found that a PAI score above 5 shows high specificity in the range of 92 to 100% with high positive predictive value (PPV) between 75 and 100. This was similar to the present study, which applied this criterion and found the specificity ranging from 90% to 97% and PPV from 82% to 93%. Similarly, the lower PAI values showed sensitivity in the range of 86% to 93%, which was 72% to 100% in the reference study. PAI ≥3 had optimal diagnostic accuracy (92.3% sensitivity, 88.5% specificity). High interobserver reliability supports clinical utility. Our results align with the original validation study by Rac MW et al., (2015)², which reported an AUC of 0.92 for PAI in predicting MAP.

The Placenta Accreta Index (PAI) demonstrated a high sensitivity of 92.3% in the present study, indicating its excellent ability to identify true-positive cases of placenta accreta spectrum (PAS) before delivery. This finding is comparable to that reported by Mathur A et al., (2019)⁷ who observed a sensitivity of 92.86% and specificity of 94.74% for the PAI in predicting morbidly adherent placenta, suggesting excellent diagnostic performance across different populations. Similarly, Bansal S et al., (2022)⁸ reported a sensitivity of 73.3%, specificity of 95.1%, positive predictive value of 91.7%, and negative predictive value of 83.0%, concluding that the PAI is a reliable screening tool for antenatal diagnosis of PAS (Rac MW et al. (2015)²). The slightly higher sensitivity observed in the present study may be attributed to standardized ultrasonographic protocols, meticulous patient selection, and interpretation by experienced maternal-fetal medicine specialists.

The original Placenta Accreta Index proposed by Rac MW et al. (2015)² demonstrated that increasing PAI scores were strongly associated with the probability of placental invasion and established the index as a robust ultrasound-based risk stratification tool. Compared with other predictive models, including the modified Triple-P score (Tovbin J et al., 2016)⁹ and standardized ultrasound grading systems (Collins SL et al., 2016)¹⁰, the PAI provides a more objective and reproducible assessment because it incorporates measurable sonographic parameters such as placental lacunae, myometrial thickness, placental location, and previous cesarean delivery rather than relying predominantly on subjective assessment of placental vascularity.

Furthermore, the excellent interobserver agreement observed in the present study ($\kappa = 0.85$) supports the reproducibility of the PAI and is consistent with recommendations by Jauniaux E et al., (2018)¹ and Collins SL et al., (2016)¹⁰ who emphasized that standardized ultrasound assessment improves diagnostic consistency and facilitates optimal prenatal management of PAS.

Strengths and Limitations: Unlike retrospective studies that rely on incomplete records, our prospective cohort ensured standardized data collection and minimized selection bias. Use of Gold-Standard Confirmation: Unlike studies relying solely on imaging, we confirmed MAP cases via intraoperative and histopathological findings, enhancing diagnostic accuracy. Our findings may not be generalizable to all populations, particularly those with different cesarean rates or ultrasound practices. Gestational Age Variability. Since PAI was assessed between 18-32 weeks, some cases of late-developing MAP may have been missed. While ultrasound is the primary diagnostic tool, MRI has superior sensitivity for posterior placenta accreta.

Conclusion

The present study concludes that the Placenta Accreta Index (PAI) is a simple, reliable, and highly accurate ultrasound-based scoring system for the antenatal prediction of placenta accreta spectrum (PAS). A PAI score of ≥3 demonstrated excellent diagnostic performance, with high sensitivity and specificity, making it an effective tool for identifying women at increased risk of morbidly adherent placenta. The excellent interobserver agreement observed in this study further supports the reproducibility and clinical applicability of the index. By integrating objective sonographic parameters, the PAI provides a standardized and reproducible method for risk stratification, reducing subjectivity in ultrasound interpretation. Early identification of high-risk cases using the PAI facilitates timely referral, multidisciplinary planning, appropriate resource allocation, and preparedness for potential obstetric hemorrhage, thereby improving maternal and fetal outcomes. Owing to its simplicity, cost-effectiveness, and ease of application, the Placenta Accreta Index should be considered a valuable adjunct to routine antenatal ultrasound evaluation, particularly in women with placenta previa and a history of previous cesarean delivery.

References

1. Jauniaux E, Bhide A, Kennedy A, Woodward P, Hubinont C, Collins S; FIGO Placenta Accreta Diagnosis and Management Expert Consensus Panel. FIGO consensus guidelines on placenta accreta spectrum disorders: Prenatal diagnosis and screening. *Int J Gynaecol Obstet.* 2018 Mar;140(3):274-280.
2. Rac MW, Dashe JS, Wells CE, Moschos E, McIntire DD, Twickler DM. Ultrasound predictors of placental invasion: the Placenta Accreta Index. *Am J Obstet Gynecol.* 2015 Mar;212(3):343.e1-7. doi: 10.1016/j.ajog.2014.10.022.
3. Htoo CN. Aspirin in prevention of adverse pregnancy outcomes in women with elevated AFP. In *BJOG-An International Journal of Obstetrics and Gynaecology* 2021 Jun 1 (Vol. 128, pp. 75-76). 111 RIVER ST, HOBOKEN 07030-5774, NJ USA: WILEY.
4. Silver RM, Fox KA, Barton JR, Abuhamad AZ, Simhan H, Huls CK, Belfort MA, Wright JD. Center of excellence for placenta accreta. *Am J Obstet Gynecol.* 2015 May; 212(5):561-8.
5. Wu X, Yang H, Yu X, Zeng J, Qiao J, Qi H, Xu H. The prenatal diagnostic indicators of placenta accreta spectrum disorders. *Heliyon.*

2023 May 17; 9(5): e16241. doi: 10.1016/j.heliyon.2023.e16241.

6. Algebally AM, Yousef RR, Badr SS, Al Obeidly A, Szmigielski W, Al Ibrahim AA. The value of ultrasound and magnetic resonance imaging in diagnostics and prediction of morbidity in cases of placenta previa with abnormal placentation. *Pol J Radiol.* 2014 Nov 12;79:409-16.
7. Mathur A, Rajoria L, Bansal A, Hemani S, Vyas J. Role of Placenta Accreta Index in Patients with Placenta Previa with Previous Cesarean: A Prospective Study. *J South Asian Feder Obst Gynae* 2019;11(6):363-367.
8. Bansal S, Suri J, Bajaj SK, Ahluwalia C, Pandey D, Mittal P. Role of placenta accreta index for diagnosis of placenta accreta spectrum in high-risk patients. *J Obstet Gynaecol India.* 2022 Aug;72(Suppl 1):55-60.
9. Tovbin J, Melcer Y, Shor S, Pekar-Zlotin M, Mendlovic S, Svirsky R, Maymon R. Prediction of morbidly adherent placenta using a scoring system. *Ultrasound Obstet Gynecol.* 2016 Oct;48(4):504-510.
10. Collins SL, Ashcroft A, Braun T, Calda P, Langhoff-Roos J, Morel O, et al. Proposal for standardized ultrasound descriptors of abnormally invasive placenta (placenta accreta spectrum disorders). *Ultrasound Obstet Gynecol.* 2016;47(3):271-275.