

ORIGINAL ARTICLE

DIAGNOSTIC ACCURACY OF ULTRASOUND FOR MORBIDLY ADHERENT PLACENTA BY USING PLACENTA ACCRETA INDEX KEEPING PER-OPERATIVE FINDINGS AS GOLD STANDARD

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Background: Morbidly adherent placenta (MAP), including placenta accreta, increta, and percreta, is a serious obstetric condition associated with significant maternal morbidity and mortality. The aim of this cross-sectional validation study was to assess the diagnostic accuracy of ultrasound, using the Placenta Accreta Index (PAI), in detecting morbidly adherent placenta (MAP) in a tertiary care hospital in Pakistan. **Methods:** A total of 81 pregnant women in the third trimester, at risk of developing MAP due to a history of two or more cesarean sections, placenta previa, or prior myomectomy independent of cesarean sections, were included in this cross-sectional Validation study. Gray scale and Doppler ultrasound were performed, and the PAI was calculated. Per-operative findings were considered as the gold standard and compared with ultrasound results. Sensitivity, specificity, and diagnostic accuracy were calculated using a 2x2 contingency table. **Results:** Among the included women, 25 (30.86%) had confirmed MAP based on perioperative findings, with varying degrees of placenta accreta (percreta, increta, and accreta). The ROC curve analysis revealed a PAI cutoff value of 4.37, yielding a sensitivity of 84.00%, specificity of 85.71%, and diagnostic accuracy of 85.19%. Lacunae, bridging vessels, and placenta previa were found to be associated with increased risk of MAP, while decreased myometrial thickness correlated with higher PAI values. **Conclusion:** This study demonstrates that ultrasound, utilizing the PAI, exhibits promising diagnostic accuracy for detecting morbidly adherent placenta in women at risk. The findings support the role of ultrasound as a valuable tool in the diagnosis of MAP, aiding in appropriate management and intervention.

Keywords: Morbidly adherent placenta; Placenta Accreta Index; Ultrasound; Diagnostic accuracy

Citation: Ahmed A, Isani A, Riaz R, Abid H, Asif B, Habiba U. Diagnostic accuracy of ultrasound for morbidly adherent placenta by using placenta accreta index keeping per-operative findings as gold standard. J Ayub Med Coll Abbottabad 2025;37(3):311–4.

DOI: 10.55519/JAMC-03-13911

INTRODUCTION

Morbidly adherent placenta (MAP), including placenta accreta, increta, and percreta, is a serious obstetric condition associated with significant maternal morbidity and mortality.¹ The incidence of MAP has been rising globally, posing a substantial challenge to healthcare providers.² Accurate diagnosis of MAP before delivery is crucial for optimal management and planning of surgical interventions to minimize complications.

Ultrasound imaging plays a pivotal role in the antenatal diagnosis of MAP, providing valuable information about placental invasion and its proximity to adjacent structures. Several ultrasound-based scoring systems have been developed to improve the diagnostic accuracy of MAP, including the Placenta Accreta Index (PAI)³ PAI integrates various ultrasound parameters, such as the presence of lacunae, tortuous vessels, myometrial thickness, and

placenta previa, to generate a numerical score indicative of the likelihood of MAP.³

In recent years, there have been advancements in ultrasound technology and evolving understanding of MAP, necessitating the evaluation of the diagnostic accuracy of PAI in contemporary clinical settings. Several studies conducted after 2018 have explored the performance of PAI in diagnosing MAP, contributing valuable insights to the existing literature. One study evaluated the diagnostic accuracy of PAI in a large cohort of pregnant women with suspected MAP. They reported a sensitivity of 87% and a specificity of 77% for PAI in identifying MAP cases, indicating its potential as a reliable tool for antenatal diagnosis.⁴ Similarly, another study demonstrated the utility of PAI in a tertiary care setting, with a sensitivity of 86.6% and a specificity of 96.6%.⁵ Furthermore, a systematic review summarized the findings of multiple studies on the diagnostic accuracy of PAI. They reported an overall sensitivity of 83.9% and a specificity of 76.3% across the included

studies, supporting the effectiveness of PAI in diagnosing MAP.⁶

Thus, the accurate antenatal diagnosis of MAP is crucial for appropriate management and optimal outcomes. PAI has shown promise as a tool for the diagnosis of MAP, but further research is needed to evaluate its performance in different populations and settings. This study aims to contribute to the growing body of evidence on the diagnostic accuracy of PAI in the Pakistani population and provide valuable insights into its utility for the antenatal diagnosis of MAP. In the context of Pakistan, where the burden of MAP is significant, there is a paucity of studies evaluating the diagnostic accuracy of PAI in local settings. Therefore, this study aims to assess the diagnostic accuracy of PAI for the detection of MAP in a tertiary care hospital in Pakistan, using per-operative findings as the gold standard. By evaluating the performance of PAI in the local population, this study will contribute to the existing literature and provide valuable insights for clinicians in Pakistan and similar healthcare settings.

MATERIAL AND METHODS

This cross-sectional Validation study was carried out at Pakistan Institute of Medical Sciences from July 20th to December 20th 2022. Women with third trimester of pregnancy who were at risk of developing morbidly adherent placenta, i.e., have history of two or more than two C-section, having placenta previa or history of myomectomy independent of C-sections were included in the study. Both gray scale and doppler ultrasound was performed and Placenta Accreta Index was calculated. All patients were followed till delivery, and those having normal delivery were then excluded. Total 81 women fulfilled the criterion and were included in the study. Per operative findings were considered as gold standard and were compared with ultrasound finding. For statistical analysis ROC curve was drawn and cut off was calculated. On basis of that cut-off value, women were graded positive or negative for morbidly adherent placenta on Ultrasound. A 2×2 contingency table was created and, sensitivity, specificity and diagnostic accuracy were calculated. Odd's ratio was applied on other ultrasound parameters. Frequencies and graphs were drawn for qualitative variables.

RESULTS

Mean age of the women was 35.70 ± 7.8 with mean gestation of 33.94 ± 3.9 . All women except two had history of more than 2 C-sections. Total 25 (30.86%) patients had morbidly adherent placenta upon per-operative findings. Among which 8 patients had percreta, 8 had accreta and 9 had increta. Placenta Accreta Index was calculated for all patients. ROC curve was drawn to find the cut-off value of Placenta Accreta Index which is shown in Figure-1.

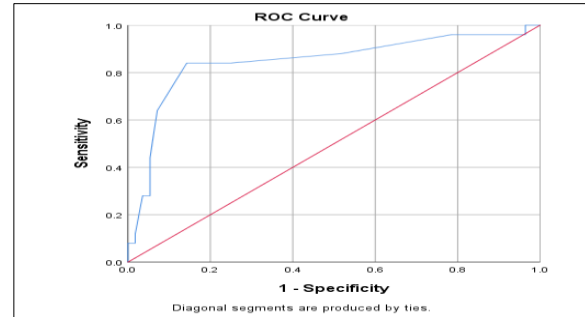


Figure-1: ROC Curve of to find the cut-off value of Placenta Accreta Index

Cutt-off value with highest sensitivity and specificity was found to be 4.37. Keeping this as cut-off, all patients having PAI equal to or higher than this were considered positive while below it was considered negative. A 2x2 contingency table was drawn and sensitivity, specificity and diagnostic accuracy was calculated which was found to be 84.00%, 85.71% and 85.19% respectively.

Table 1: Crosstabulation between per-operative findings and Doppler findings.

Per-operative * PAI Crosstabulation				
Count		PAI		Total
		yes	no	
Per-operative	Positive	21	4	25
	Negative	8	48	56
Total		29	52	81

Table-2: Sensitivity and Specificity of Doppler Findings in Diagnosing PA

Statistic	Value	95% CI
Sensitivity	84.00%	63.92% to 95.46%
Specificity	85.71%	73.78% to 93.62%
Positive Likelihood Ratio	5.88	3.03 to 11.42
Negative Likelihood Ratio	0.19	0.08 to 0.46
Disease prevalence (*)	30.86%	21.07% to 42.11%
Positive Predictive Value (*)	72.41%	52.76% to 87.27%
Negative Predictive Value (*)	92.31%	81.46% to 97.86%
Accuracy (*)	85.19%	75.55% to 92.10%

(*) These values are dependent on disease prevalence.

PAI includes grading of lacunae, torturous blood vessels, myometrial thickness and placenta previa as score factors upon ultrasound. Lacunae wise distribution showed Grade II and Grade III lacunae to be commonly found in MAP positive patients.

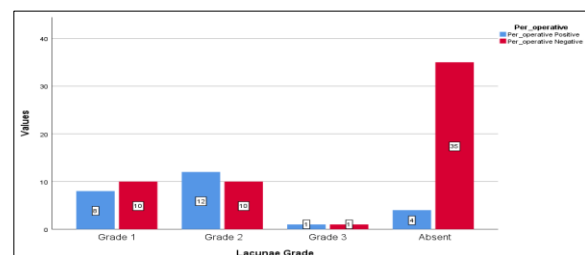


Figure-2: Bar graph depicting per operative positive finding and Lacunar Grades.

Bridging vessels (OR=8.66, $p<0.001$) and Placenta Previa (OR=19.5, $p<0.001$) were found to significantly increase the risk of MAP. A decrease in myometrial thickness ($r=0.485$, $p<0.001$) was found to be associated with increased PAI values.

Table-3: Crosstabulation between per operative findings and presence of bridging vessels.

Per-operative * Bridging vessels Crosstabulation				
Count				
		Bridging vessels		Total
		yes	no	
Per-operative	Positive	10	15	25
	Negative	4	52	56
Total		14	67	81
OR (P-Value)		8.66 ($p<0.001$)		

Table-4: Cross tabulation showing presence of Placenta Previa in peroperative positive and negative cases of placenta accreta.

Per-operative * Placenta Previa Crosstabulation				
Count				
		previa		Total
		Yes	No	
Per-operative	Positive	15	10	25
	Negative	4	52	56
Total		19	62	81
OR (P-Value)		19.5 ($p<0.001$)		

DISCUSSION

The diagnostic accuracy of ultrasound in detecting morbidly adherent placenta (MAP) has been a subject of significant research interest in recent years. Early detection plays a crucial role in optimizing patient care and improving maternal and foetal outcomes. This cross-sectional validation study aimed to assess the diagnostic accuracy of ultrasound, using the Placenta Accreta Index (PAI), in a tertiary care hospital in Pakistan. The results of this study demonstrated promising diagnostic accuracy for ultrasound in detecting morbidly adherent placenta in women at risk. The sensitivity of 84.00% and specificity of 85.71% indicate that ultrasound has the potential to effectively identify cases of MAP, providing clinicians with valuable information for appropriate management and intervention. These findings align with several recent studies conducted worldwide.

A study investigated the accuracy of ultrasound in diagnosing placenta accreta spectrum disorders, including morbidly adherent placenta. The authors reported a sensitivity of 87.03% and specificity of 86.34% for the diagnosis of MAP, highlighting the reliable performance of ultrasound in detecting this condition.⁷ The results of our study are consistent with their findings, further supporting the role of ultrasound in the diagnosis of MAP.

Another study demonstrated the utility of PAI in a tertiary care setting, with a sensitivity of 86.6% and a

specificity of 96.6%.⁵ Although our study yielded slightly lower sensitivity and specificity values, the diagnostic accuracy was still substantial, reinforcing the potential of ultrasound as a valuable tool in clinical practice.

Furthermore, several recent studies have explored additional ultrasound parameters and techniques to enhance the diagnostic accuracy of MAP. Collins *et al.* investigated the role of three-dimensional power Doppler ultrasound in identifying placenta accreta spectrum disorders, including morbidly adherent placenta. The authors reported a sensitivity of 100% and specificity of 92% for the diagnosis of MAP using this technique.⁸ Their findings highlight the potential of advanced ultrasound techniques to improve the accuracy of MAP detection.

In a study by Windrim *et al.* (2016), the authors evaluated the utility of contrast-enhanced ultrasound (CEUS) in diagnosing placenta accreta spectrum disorders and proposed that CEUS can serve as a strong adjunct to conventional ultrasound for the detection of placental disorders.⁹

While this study provides valuable insights into the diagnostic accuracy of ultrasound for MAP, there are some limitations to consider. First, the study was conducted in a single tertiary care hospital in Pakistan, which may limit the generalizability of the findings to other settings. The sample size was also relatively small, warranting further validation with larger cohorts.

CONCLUSION

The study demonstrates that ultrasound, utilizing the Placenta Accreta Index, exhibits promising diagnostic accuracy for the detection of morbidly adherent placenta in women at risk. The results align with previous studies conducted worldwide, emphasizing the important role of ultrasound in the diagnosis of MAP. Future research should focus on multi-center studies with larger sample sizes and further exploration of advanced ultrasound techniques to improve the detection and management of morbidly adherent placenta.

AUTHORS' CONTRIBUTION

AA: Conceptualization, data collection, analysis, interpretation. AI: Conceptualization, proof reading. RR: Write-up, data analysis. HA, BA, UH: Data collection.

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Submitted: October 7, 2024

Revised: May 4, 2025

Accepted: June 5, 2025

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