Research Article

Placenta Accreta Index Score as a Predictor of Placenta Accreta Spectrum, E-Cadherin Expression, and Maternal–Neonatal Outcomes

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Abstract

Objective: To evaluated the Placenta Accreta Index (PAI) score for its association with histopathological diagnosis, E-cadherin expression, and clinical outcomes in Placenta Accreta Spectrum (PAS) disorders.

Methods: A retrospective cross-sectional analysis was conducted on 81 patients with PAS at a tertiary referral center. Data on PAI scores, histopathology, and maternal/neonatal outcomes were collected. Statistical analysis compared outcomes between patients with PAI scores ≥4 and <4.

Results: A PAI score ≥4 was not significantly associated with the final histopathological diagnosis of PAS (p=1.000). E-cadherin expression was lower in PAS tissue, but not significantly correlated with PAI score. However, a PAI score ≥4 was significantly associated with increased intraoperative blood loss (1275 mL vs. 968 mL, p=0.005) and a higher likelihood of requiring blood transfusion (RR 1.56, 95% CI 1.126–2.150, p=0.007). No significant associations were found between PAI score and adverse neonatal outcomes.

Conclusion: The PAI score is a practical tool for predicting surgical morbidity, specifically hemorrhage and transfusion risk, in pregnancies clinically suspected of PAS, supporting its use for preoperative planning in resource-limited settings. Its utility as a primary diagnostic marker for histopathological invasion appears limited in a high-risk referral population.

Keywords: E-cadherin, maternal outcome, neonatal outcome, placenta accreta spectrum, PAI Score.

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INTRODUCTION

Placenta Accreta Spectrum (PAS) disorders are characterized by abnormal invasion of placental trophoblasts into the uterine myometrium and beyond, representing a major challenge in modern obstetrics.[1] PAS is a leading cause of severe maternal morbidity and mortality, with increasing incidence linked to rising rates of cesarean delivery and other uterine procedures, such as curettage, myomectomy, and assisted reproductive techniques. These interventions may disrupt the decidua basalis, facilitating excessive trophoblastic invasion.[2-4]

The pathophysiology of PAS involves defective decidualization at previous uterine scar sites. Reduced expression of E-cadherin, a key molecule responsible for epithelial integrity and cell adhesion, is believed to weaken the maternal–fetal interface and promote abnormal placental invasion.[5,6]

Early and accurate prenatal diagnosis is essential for optimal management of PAS. Although magnetic resonance imaging (MRI) provides high diagnostic accuracy, its use is limited in resource-constrained settings due to cost and availability. Ultrasound-based scoring systems, such as the Placenta Accreta Index

(PAI) Score, offer a practical and cost-effective alternative. However, data correlating this tool with underlying pathophysiology and clinical outcomes remain limited.[2,7,8]

This study aims to evaluate the association between the PAI Score and histopathological confirmation of PAS, E-cadherin expression, and maternal and neonatal outcomes, to support its role in clinical practice, particularly in resource-limited settings.

METHODS

A retrospective cross-sectional study was conducted using medical records of patients diagnosed with morbidly adherent placenta (ICD-10 code O43.2) at Dr. Kariadi General Hospital, Semarang, from January 2019 to December 2023. Ethical approval was obtained (No. 16137/KEPK-RSDK/2024), and informed consent was waived due to the retrospective design.

Inclusion criteria were patients with a diagnosis of Placenta Accreta Spectrum (PAS) and at least one risk factor (prior uterine surgery, assisted reproductive technology, placenta previa, or retained placenta). Cases with incomplete records or unavailable Immunohistochemistry (IHC) samples were excluded.

Data collected included maternal characteristics, Placenta Accreta Index (PAI) score, delivery details, and maternal–neonatal outcomes. Operative complications were defined as massive hemorrhage (≥1500 mL blood loss or ≥4 units transfusion) or visceral injury. Placental tissue samples were analyzed using standard IHC techniques, and slides were evaluated by a blinded pathologist using the Allred scoring system.

PAS diagnosis was based on histopathology, while PAS-negative cases served as controls for exploratory IHC comparison. Statistical analysis was performed using SPSS version 24.0. Categorical variables were analyzed using the Chi-square test, with $p<0.05$ considered statistically significant.

RESULTS

Table 1. Characteristics of the study population

Variabel	n	%	Mean ± SD	Median (min – max)
Gravida				
Multigravida	75	92.6		
Grande multigravida	6	7.4		
Paritas				
Primipara	30	37.0		
Multipara	51	63.0		
Abortus				
Yes	24	29.6		
No	57	70.4		
Age				
≤ 35	58	71.6		
> 35	23	28.4		
Gestation (weeks)			35.4 ± 2.52	36 (22 – 41)
Antecedent pregnancy (years)			4.1 ± 2.43	3 (1 – 13)
Previous Cesarean Delivery				
Yes	78	96.3		
No	3	3.7		
Antepartum Hemorrhage				
Yes	31	38.3		
No	50	61.7		
PAS Incidence				
Yes	78	96.3		
No	3	3.7		
Fetal Position				
Head	57	70.4		
Other	24	29.6		

PAI Score			4.02 ± 1.813	4.50 (0.25 – 8.50)
< 4	37	45.7		
≥ 4	44	54.3		
Hysterectomy				
Yes	23	28.4		
No	58	71.6		
Blood Loss (ml)			1135 ± 1008	1000 (0 – 6000)
Complication				
Yes	50	61.7		
No	31	38.3		
Anemia				
Yes	59	72.8		
No	22	27.2		
Blood Transfusion				
Yes	57	70.4	2.3 ± 1.242	2 (0 – 5)
No	24	29.6		
ICU Admission				
Yes	11	13.6		
No	70	86.4		
NICU Admission				
Yes	32	39.5		
No	49	60.5		
Birth Weight (gram)			2541 ± 451	2550 (600 – 3500)
<2500	37	45.7		
≥2500	44	54.3		
APGAR Score				
Vigorous Baby	66	81.5		
Asphyxia	15	18.5		
Prematurity				
Yes	40	49.4		
No	41	50.6		

Table 2. Association between PAI Score and Maternal Outcomes

Maternal Outcomes	PAI Score		*P-value*	RP (95% CI)
	≥4	**<4**		
PAS Incidence	42	36	1.000	0.98 (0.902 – 1.067)
ICU admission	8	3	0.321	2.24 (0.641 – 7.849)
Blood loss	44	36	0.847	1.03 (0.974 – 1.084)
Blood transfusion	37	20	0.007*	1.56 (1.126 – 2.150)
Hysterectomy	16	7	0.137	1.9 (0.887 – 4.164)
Anemia	35	24	0.219	1.23 (0.926 – 1.623)
Surgery Complications	30	20	0.283	1.26 (0.881 – 1.806)

Table 3. Association between PAI Score and Neonatal Outcomes

Neonatal Outcomes	PAI Score		*P-value*	RP (95% CI)
	≥4	**<4**		
NICU admission	19	13	0.610	1.23 (0.706 – 2.138)
Asphyxia	10	5	0.438	1.68 (0.631 – 4.483)
Low Birth Weight	22	15	0.530	1.23 (0.756 – 2.012)
Preterm Birth	24	16	0.429	1.26 (0.799 – 1.992)

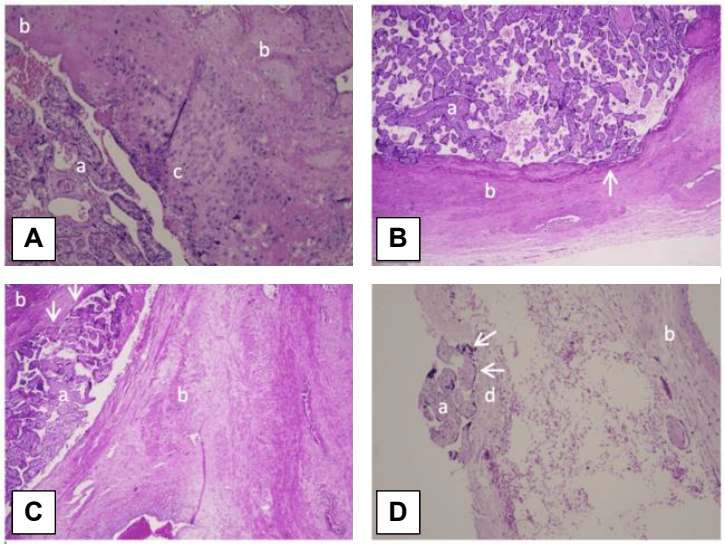

Figure 1. Histopathology slides presenting ranges of Placenta Accreta Spectrums.

A. Normal Placenta. B. Placenta Accreta. C. Placenta Increta. D. Placenta Percreta. a) chorionic villi; b) myometrium; c) decidua d) myometrium serosa. Arrow : absent of decidua resulting in further invasion of chorionic villi.

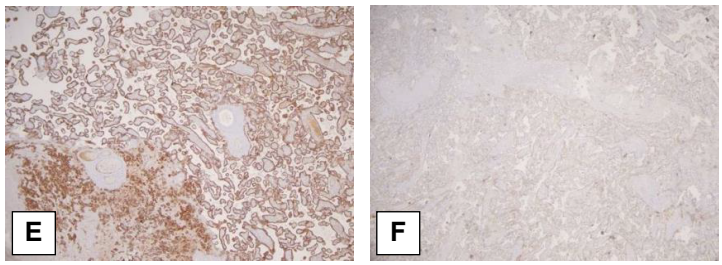

Figure 2. E-Cadhern IHC staining in Normal (E.) and Placenta Accreta Spectrum (F.)

DISCUSSION

This study evaluated the Placenta Accreta Index (PAI) score in 81 patients with Placenta Accreta Spectrum (PAS). The main findings were; no significant association between PAI score and histopathological diagnosis of PAS, lower E-cadherin expression in PAS tissue without significant correlation with PAI score, and a higher PAI score (≥4) was significantly associated with increased intraoperative blood loss and transfusion requirements, supporting its role as a predictor of maternal morbidity.

A PAI score ≥4 was associated with higher mean intraoperative blood loss (1275 mL vs. 968 mL, p=0.005) and increased likelihood of blood transfusion. This supports its clinical utility in preoperative planning, including blood preparation and multidisciplinary management.[9,10] The higher rate of hysterectomy in the PAI ≥4 group (36.3% vs. 18.9%) further reinforces its value in surgical preparedness and patient counseling, consistent with current evidence and guidelines.[10,11]

The absence of association between PAI score and histopathological diagnosis may be explained by the referral-center setting, where patients are preselected based on clinical suspicion (e.g., placenta previa), limiting its diagnostic discrimination. Thus, the PAI score appears more useful as a predictor of morbidity in suspected PAS rather than as a general screening tool.

Lower E-cadherin expression in PAS tissue supports its role in abnormal placentation, as impaired cell adhesion facilitates trophoblastic invasion.[12,13] Although a trend toward lower expression was observed in patients with higher PAI scores, this was not statistically significant, possibly due to small sample size and the multifactorial nature of invasion involving

other molecules such as integrins and matrix metalloproteinases.[13]

No significant association was found between PAI score and adverse neonatal outcomes. The mean gestational age at delivery was 35.4 weeks, reflecting a balance between fetal maturity and hemorrhage risk. However, the high rate of low birth weight (45.7%) highlights the neonatal risks of PAS. Current evidence supports planned delivery at 34–36 weeks with multidisciplinary care, including neonatal support.[14,15] Clinically, the PAI score can be used as a practical tool to stratify hemorrhage risk and guide preoperative planning, particularly in resource-limited settings.

STUDY LIMITATIONS

This study has several limitations. Its retrospective design and referral-center setting introduce potential selection bias toward high-risk PAS cases. Significant missing data for E-cadherin analysis (only 28 of 81 cases) limit the statistical power and generalizability of molecular findings. In addition, the single-center setting and variability in surgical practices may affect the generalizability of morbidity outcomes, while the absence of a standardized PAI scoring protocol limits its diagnostic interpretation. Despite these limitations, this study provides valuable insights into PAS detection and risk stratification, particularly in resource-limited settings.

CONCLUSION

This study supports the use of the PAI score as a valuable tool for predicting surgical morbidity, particularly hemorrhage and transfusion requirements, in pregnancies suspected of PAS. It should guide preoperative management, including multidisciplinary planning, blood product preparation, and patient counseling regarding the potential need for hysterectomy. For screening purposes, our findings suggest that the PAI score should be applied in patients with established risk factors and suspicious ultrasound findings, in line with current guidelines. Future prospective, multicenter studies with standardized specimen collection are needed to validate the role of molecular markers such as E-cadherin and to refine the integration of imaging-based scores with biological predictors for comprehensive PAS risk stratification.

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