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Sonographic Profiles for Risk Stratification and Prognostic Assessment of Antepartum Hemorrhage in Placenta Accreta Spectrum: A Systematic Review

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Objectives

To review ultrasound parameters associated with APH-related outcomes and synthesize PAS-specific sonographic prognostic profiles.

Discussion

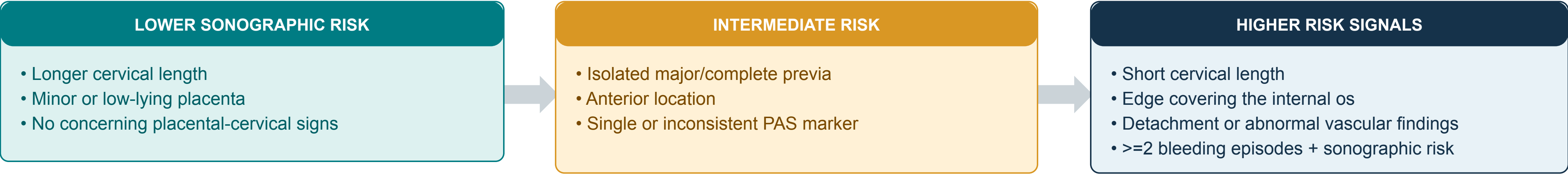
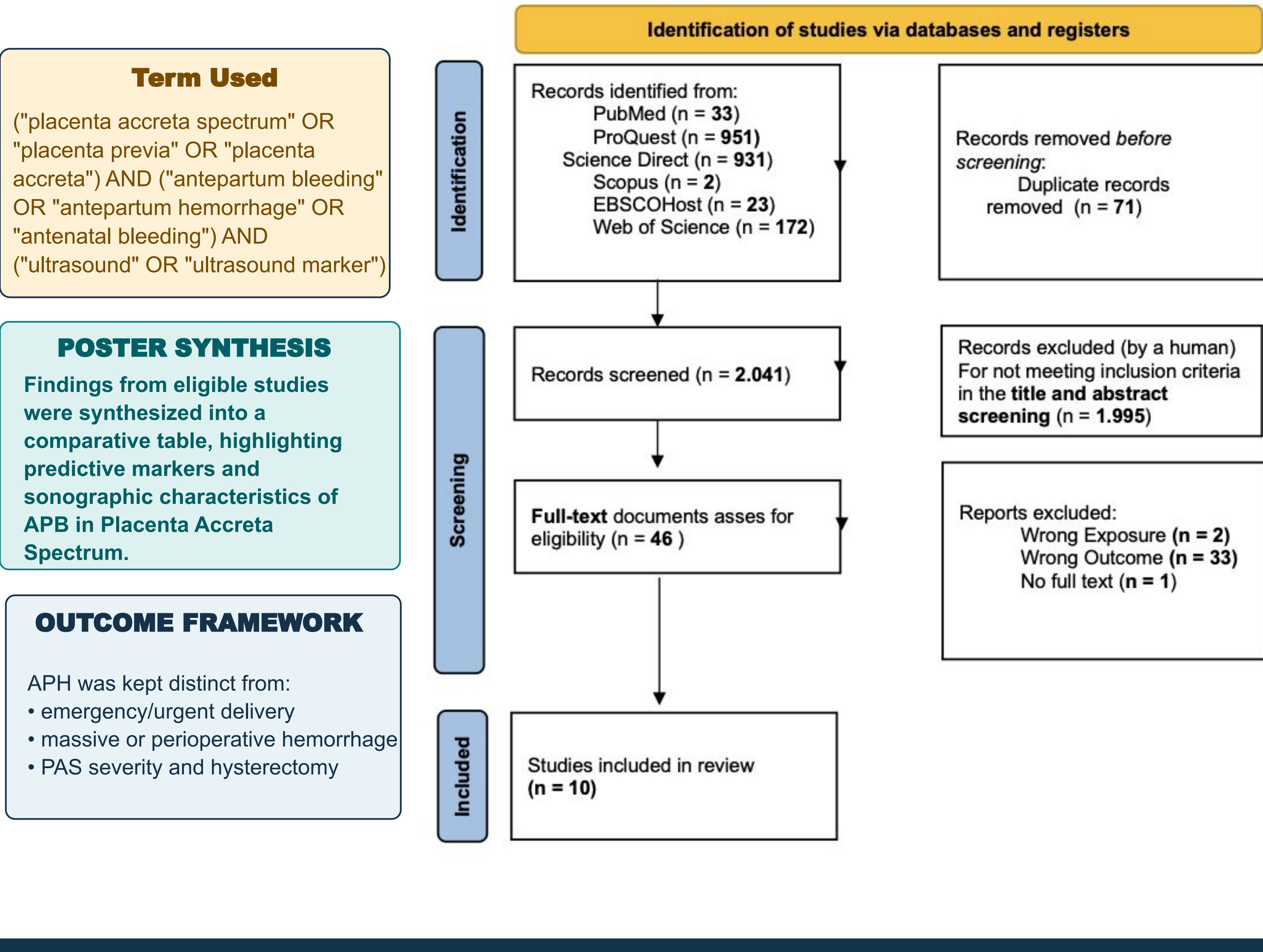
- Cervical length was the most frequently evaluated marker.
- Major/complete previa and internal-os coverage repeatedly tracked bleeding-related outcomes.
- PAS vascular and placental-myometrial signs showed potential, but adjusted evidence was limited.
- APH thresholds, imaging timing, and outcome definitions restricted direct comparison.

Evidence Map

SONOGRAPHIC MARKER	k	ANCHOR ESTIMATE	QUALITATIVE INTERPRETATION
Cervical length	6	Short CL: aOR 3.80-3.89; per 1-mm increase: aOR 0.972 (95% CI 0.952-0.993)	Mixed evidence
Cervical funneling	1	Mild vs no APH: aOR 4.66 (1.63-13.31); progression: aOR 0.93 (0.16-5.40)	Limited evidence
Major/complete previa or internal-os coverage	7	Positive adjusted anchors: aOR 2.12-2.16	Mixed evidence
Placental thickness	1	aOR 1.02 per mm (1.00-1.03)	Limited evidence
Sonolucency or marginal sinus	1	APH 2.3% vs 0.7%, p = 0.40; no adjusted estimate	Limited evidence
Anterior placental location	6	aOR 1.66 (1.14-2.43) in one model; most others NS	Mixed evidence
Lacunae or vascular Doppler signs	3	Adjusted findings mostly NS or inconsistent	Mixed evidence
Clear-zone or myometrial abnormality	3	Partially absent myometrium: aOR 2.02 (1.29-3.14); others NS/inconsistent	Mixed evidence
Bladder-line interruption	2	aOR 0.44 (0.06-3.46) in ADOPAD PP-only analysis; other result NS	Limited evidence
Uteroplacental detachment	1	aOR 22.40 (2.04-246.34); HR 4.03 (1.56-10.43)	Limited evidence

Methods

A systematic search across 6 databases (PubMed, ScienceDirect, Scopus, EBSCOHost, Web of Science, ProQuest) yielded 2,041 records, narrowing to 10 predictive-marker synthesized qualitatively due to outcome heterogeneity



This framework represents qualitative evidence synthesis and requires prospective external validation before clinical implementation.

RESULTS

Short cervical length and internal-os showed the clearest recurring signals; PAS-specific signs remained heterogeneous.

10

Included studies

6

Studies evaluating cervical length

7

Major/complete previa or internal-os coverage

2016-2026

Publication range

Predominantly retrospective (8/10) | TVUS used in 9/10 studies | MRI adjunct in 2/10 | APH definitions were heterogeneous

Table 1. Characteristics and Predictive Markers for Antepartum Hemorrhage in Placenta Accreta Spectrum with Placenta Previa						
No	Author (Year)	Study Design	Study Population	Diagnostic Criteria for APB	Sonographic Findings	Outcomes
1	Baldassarre et al. (2016)	Retrospective cohort study	201 singleton pregnancies • Sonolucency ≥0.7 cm present (n=45) • Sonolucency ≥0.7 cm absent (n=156)	Antepartum hemorrhage (APH) was identified via medical record review and recorded as an adverse obstetric outcome.	• Placental sonolucency (anechoic/heterogeneous area ≥0.7 cm) • Marginal sinus • Subchorionic hemorrhage • Placenta previa	Sonulency Present (45) vs Sonulency Absent (n 156) • Antepartum hemorrhage: 1 (2.3%) vs 1 (0.7%), p = 0.40 • Placenta previa: 6 (13.3%) vs 10 (6.4%), p = 0.13
2	Rac et al. (2017)	Retrospective cohort study.	125 women, >1 prior cesarean + low-lying placenta/previa • Placenta accreta (n=43) • No accreta (n=82)	Clinically defined as vaginal bleeding or preterm labor symptoms leading to an unscheduled delivery before 36 weeks.	• Cervical length (<32 wk and 32–34 wk epochs) • Short cervix (≤3 cm)	Accreta subgroup, CL ≤3 cm (n=12) vs CL >3 cm (n=15): • Bleeding/labor: 2 (17%) vs 6 (40%), p = 0.19 • Incrета/percreta: 4 (33%) vs 8 (53%), p = 0.3
3	Altraige et al. (2019)	Retrospective cohort study	328 Placenta Previa cases; • Normal Cervical Length (n=170) • Short Cervical Length (n=158)	Vaginal bleeding occurring ≥24 weeks before labor with a massive volume >2000 mL.	• TVUS Cervical Length • Distance between lower placental edge to internal OS • Placental invasion by US • Placental location: Anterior and Posterior • Type of placenta previa by US: Low lying, Incomplete, and Complete	Short CL ≤30 mm (n=158) vs Normal CL >30 mm (n=170) • Antepartum hemorrhage: 117 (74.1%) vs 75 (44.1%), p < 0.001, aOR = 3.86 (2.37–6.29), p < 0.001
4	Huang, Shiyun et al. (2021)	Retrospective study	493 pregnant women complicated with Placenta Previa (PP).	Repeated vaginal bleeding (≥2 times) occurring after 20 weeks of gestation.	• Placental edge relative to the internal cervical os: edge over os (complete/central PP) vs low-lying placenta (<2 cm from the os) • PP type: marginal, partial, central • Placental location • Placental invasion assessed by TVUS after 24 weeks (or intraoperatively if imaging was unavailable)	Repeated bleeding (n=211) vs Non-bleeding/very small bleeding (n=282) • Placenta edge over internal os: 174 (82.5%) vs 176 (62.4%), OR = 4.385 (95% CI 2.454–8.372), p < 0.001 • Anterior placenta: 114 (54.0%) vs 150 (53.2%), OR = 1.041 (95% CI 0.728–1.489), p = 0.825 • Placenta increta: 59 (27.9%) vs 96 (34.0%), OR = 0.752 (95% CI 0.510–1.109), p = 0.151
5	Kuribayashi et al. (2021)	Retrospective cohort	233 singleton pregnancies with placenta previa; • APH (n=130) • No hemorrhage (n=103) Low-lying placenta excluded.	Painless genital bleeding from the placenta during pregnancy.	• Placental position: anterior vs posterior • PP type: marginal (reference), partial, complete • Placenta previa diagnosed by ultrasonography and/or MRI within 1 week before cesarean delivery	Placenta previa with APH (n=130) vs Placenta previa without APH (n=103) • Anterior placenta: 34 (26.2%) vs 16 (15.5%), p = 0.07; aOR = 1.72 (95% CI 0.85–3.49), p = 0.131 • Complete PP: 59 (45.4%) vs 44 (42.7%); partial PP: 17 (13.1%) vs 8 (7.8%); marginal PP: 54 (41.5%) vs 51 (49.5%), overall p = 0.33
6	Long et al. (2021)	Single-center retrospective study.	535 Placenta Previa cases; • No Antepartum Hemorrhage (n=302) • Antepartum Hemorrhage (n=233)	Vaginal bleeding occurring after 20 weeks gestation until delivery with a total blood loss of ≥20 mL.	• Antepartum cervical length (mm), analyzed continuously • PP type: marginal, partial, complete • Placental location: anterior, posterior, other • Partially absent overlying myometrium • Loss of retroplacental clear zone • Placental lacunae: 0, 1, ≥2 • Uterovesical hypervascularity Doppler grades I–III • PAS type: no accreta, adherenta, increta, percreta	Placenta Previa with APH (n=233) vs Placenta Previa without APH (n=302) • Antepartum cervical length: 31.0 (25.6–38.0) vs 35.0 (29.6–40.0) mm, p = 0.001, aOR (per 1-mm increase): 0.972 (95% CI 0.952–0.993), p = 0.010 • Complete placenta previa: 183 (78.5%) vs 194 (64.2%), p = 0.001, aOR (vs marginal): 2.121 (95% CI 1.208–3.732), p = 0.009 • Partial placenta previa aOR (vs marginal): 1.606 (95% CI 0.798–3.234), p = 0.185 • Anterior placenta: 126 (54.1%) vs 112 (37.1%), p = 0.001, aOR (vs posterior): 1.864 (95% CI 1.139–2.430), p = 0.008 • Partially absent overlying myometrium: 82 (35.2%) vs 47 (15.6%), p = 0.001, aOR: 2.015 (95% CI 1.293–3.141), p = 0.002 • Loss of retroplacental clear zone: 83 (35.6%) vs 50 (16.6%), p = 0.001 • Placental lacunae ≥2: 63 (27.0%) vs 47 (15.6%), p = 0.001 • Uterovesical hypervascularity grade I / II / III: 19 (8.2%) / 42 (18.0%) / 37 (15.9%) vs 15 (5.0%) / 34 (11.3%) / 21 (7.0%), p = 0.001
7	Mitsuzuka et al. (2022)	Retrospective chart review.	129 Placenta Previa cases; • No Antepartum Hemorrhage (n=103) • Antepartum Hemorrhage (n=26)	Uncontrollable, massive hemorrhage during the antepartum phase necessitating an emergency.	• Serial TVUS CL every 2 weeks from 20–35 weeks; shortest recorded CL used. • Short CL <30 mm vs normal CL ≥30 mm • ROC-derived CL cutoff 35 mm for APH prediction • PP type: complete, partial, marginal; dominant placental location: anterior, posterior, other	Short cervical length <30 mm (n=27) vs Normal CL ≥30 mm (n=102) • Antepartum hemorrhage (APH): 11 (40.7%) vs 15 (14.7%), p = 0.003, OR: 3.99 (95% CI 1.55–10.24), p = 0.004, aOR: 3.80 (95% CI 1.36–10.65), p = 0.011 • Minor antepartum hemorrhage: 14 (51.9%) vs 41 (40.2%), p = 0.276, OR: 5.05 (95% CI 1.94–13.15), p < 0.001, aOR: 4.88 (95% CI 1.79–13.33), p = 0.002
8	ADOPAD Study Group (2024)	Secondary analysis of a multicenter prospective observational study.	450 women (97 with placenta previa + PAS, 353 with placenta previa only).	Defined clinically by the need for Emergency Cesarean Delivery (CD) due to cumulative maternal bleeding > 500 mL or severe/persistent vaginal bleeding causing hemodynamic instability.	• TAUS and TVUS at ≥26+0 weeks • Interrupted retroplacental hypoechoic space • Interrupted hyperchoicogenic bladder line • Abnormal placental lacunae (Finberg grade 3; often with turbulent flow) • Presence of ≥1, ≥2, or all 3 PAS signs • CL <25 mm; placental thickness (mm); anterior placenta; placenta previa major vs minor	Placenta previa and PAS (n=97): Emergency CD (20) vs Elective CD (77) • ≥1 ultrasound sign: Sensitivity: 80.0%, Specificity: 7.8% • ≥2 ultrasound signs: Sensitivity: 57.9%, Specificity: 8.8% • All 3 ultrasound signs: Sensitivity: 33.3%, Specificity: 12.0% Placenta previa only (n=353): Emergency CD (110) vs Elective CD (243) • ≥1 ultrasound sign: Sensitivity: 18.2%, Specificity: 83.1% • ≥2 ultrasound signs: Sensitivity: 7.2%, Specificity: 90.6% • All 3 ultrasound signs: Sensitivity: 0.0%, Specificity: 97.1%
9	Treffers et al. (2025)	Retrospective cohort study	430 Placenta Previa cases; • No Antepartum Hemorrhage (n=318) • Antepartum Hemorrhage (n=112)	Vaginal bleeding severe enough to require hospital admission.	• PP grade by relation to the internal os: minor (grades 1–2) vs major (grades 3–4) • Placental location: anterior vs non-anterior/posterior • PP defined on ultrasound as placental edge <20 mm from the internal os after ≥24 weeks • CL was not analyzed because measurements were inconsistent over the 14-year period	Admitted with APH (112) vs No APH admissions (318) • Major PP (Grade 3+4): 76 (67.9%) vs 166 (52.2%), p = 0.004, aOR: 2.16 (95% CI 1.26–3.43), p = 0.001 • Anterior placenta: 40 (35.7%) vs 101 (31.7%), p = 0.443 • Gestational age at birth: 36 (35–37) vs 37 (36–38) weeks, p < 0.001
10	Aryananda et al. (2026)	Prospective study	123 Suspected PAS cases (Non PAS Deshiscence with previa were included); • No Antepartum Hemorrhage (n=73, 59.3%) • Mild Antepartum Hemorrhage (n=31, 25.2%) • Substantial Antepartum Hemorrhage (n=19, 15.4%)	• Substantial Antepartum Hemorrhage defined as blood loss ≥500 mL. • Mild Antepartum Hemorrhage defined as blood loss <500 mL using the Bosc technique.	• TVUS cervical length • Cervical funneling • Uteroplacental detachment near internal os • PAS markers: - Gray Scale: loss of Cervical Lengthear zone, bladder wall interruption, myometrial thinning, placental bulge, distorted bladder wall, abnormal lacunae, parametrial bulge - Doppler: uterovesical hypervascularity, Subplacental hypervascularity, Lacunae feeding vessel, bridging vessels, Parametrial hypervascularity	Substantial Antepartum Hemorrhage vs Mild Antepartum Hemorrhage • Gray Scale - loss of Cervical Lengthear zone: 15 (78.95%)/4 (21.05%) vs 27 (87.10%)/4 (12.90%), p = 0.459 - bladder wall interruption: 11 (57.89%)/8 (42.11%) vs 17 (54.84%)/14 (45.16%), p = 1.0 - myometrial thinning: 16 (84.21%)/3 (15.79%) vs 27 (87.10%)/4 (12.90%), p = 1.0 - placental bulge: 11 (57.89%)/8 (42.11%) vs 15 (48.39%)/16 (51.61%), p = 0.718 - distorted bladder wall: 5 (26.32%)/14 (73.68%) vs 3 (9.68%)/28 (90.32%), p = 0.232 - abnormal lacunae: 15 (78.95%)/4 (21.05%) vs 20 (64.52%)/11 (35.48%), p = 0.446 - parametrial bulge: 3 (9.68%)/28 (90.32%) vs 3 (15.79%)/16 (84.21%), p = 0.661 • Doppler - uterovesical hypervascularity: 15 (78.95%)/4 (21.05%) vs 22 (70.97%)/9 (29.03%), p = 0.742 - subplacental hypervascularity: 16 (84.21%)/3 (15.79%) vs 27 (87.10%)/4 (12.90%), p = 1.0 - lacunae feeding vessel: 14 (73.68%)/5 (26.32%) vs 18 (58.06%)/13 (41.94%), p = 0.416 - bridging vessels: 13 (68.42%)/6 (31.58%) vs 21 (67.74%)/10 (32.26%), p = 1.0 - parametrial hypervascularity: 3 (15.79%)/16 (84.21%) vs 5 (16.13%)/26 (86.87%), p = 1.0 • TVUS - Cervical Length: 11 (57.89%) vs 16 (51.61%), p = 0.374 - Cervical Funneling: 11 (57.89%)/8 (42.11%) vs 16 (51.61%)/15 (48.39%), p = 0.888 - Uteroplacental detachment: 7 (36.84%)/12 (63.16%) vs 1 (3.23%)/30 (96.77%), p = 0.003 - Intracervical Hypervascularity: 12 (63.16%)/7 (36.84%) vs 14 (45.16%)/17 (54.84%), p = 0.345

Conclusion

Short cervical length and placental coverage of the internal os were the most recurrent prognostic signals, whereas individual PAS diagnostic signs showed heterogeneous associations with APH-related outcomes. Standardized APH definitions and prospectively validated multimarker models are needed before these findings can guide delivery timing.



<https://s.id/SupplementaryEP1712>