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Trimester-specific diagnostic accuracy of ultrasound for detection of placenta accreta spectrum: systematic review and meta-analysis

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KEYWORDS: first trimester; invasive placenta; morbidly adherent placenta; placenta accreta; second trimester; sonography; third trimester; ultrasound

CONTRIBUTION

What are the novel findings of this work?
This systematic review and meta-analysis demonstrated that ultrasound has a sensitivity of 86% (95% CI, 78–92%) and specificity of 63% (95% CI, 55–70%) during the first trimester, and a sensitivity of 88% (95% CI, 84–91%) and specificity of 92% (95% CI, 85–96%) during the second/third trimester, for detecting placenta accreta spectrum (PAS) in a high-risk population.

What are the clinical implications of this work?
Performing first-trimester ultrasound screening for high-risk PAS patients could potentially enhance detection rates and enable earlier referrals to specialized centers for pregnancy management.

ABSTRACT

Objective *To assess the diagnostic accuracy of ultrasound for detecting placenta accreta spectrum (PAS) during the first trimester of pregnancy and compare it with the accuracy of second- and third-trimester ultrasound examination in pregnancies at risk for PAS.*

Methods *PubMed, EMBASE and Web of Science databases were searched to identify relevant studies published from inception until 10 March 2023. Inclusion criteria were cohort, case–control or cross-sectional studies that evaluated the accuracy of ultrasound examination performed at < 14 weeks of gestation (first trimester) or ≥ 14 weeks of gestation (second/third trimester) for the diagnosis of PAS in pregnancies with clinical risk factors. The primary outcome was the diagnostic accuracy of sonography in detecting PAS in the first trimester, compared with the accuracy of ultrasound examination in the second and third trimesters. The secondary outcome was the diagnostic accuracy of each sonographic marker individually across the trimesters of pregnancy. The reference standard was PAS confirmed at pathological or surgical examination. The potential of ultrasound and different ultrasound signs to detect PAS was assessed by computing summary estimates of sensitivity, specificity, diagnostic odds ratio and positive and negative likelihood ratios.*

Results *A total of 37 studies, including 5764 pregnancies at risk of PAS, with 1348 cases of confirmed PAS, were included in our analysis. The meta-analysis demonstrated that ultrasound had a sensitivity of 86% (95% CI, 78–92%) and specificity of 63% (95% CI, 55–70%) during the first trimester, and a sensitivity of 88% (95% CI, 84–91%) and specificity of 92% (95% CI, 85–96%) during the second/third trimester. Regarding sonographic markers examined in the first trimester, lower uterine hypervascularity exhibited the highest sensitivity (97% (95% CI, 19–100%)), and uterovesical interface irregularity demonstrated the highest specificity (99% (95% CI, 96–100%)). In the second/third trimester, loss of clear zone had the highest sensitivity (80% (95% CI, 72–86%)), and uterovesical interface irregularity exhibited the highest specificity (99% (95% CI, 97–100%)).*

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Conclusions *First-trimester ultrasound examination has similar accuracy to second- and third-trimester ultrasound examinations for the diagnosis of PAS. Routine first-trimester ultrasound screening for patients at high risk of PAS may improve detection rates and allow earlier referral to tertiary care centers for pregnancy management. © 2024 International Society of Ultrasound in Obstetrics and Gynecology.*

INTRODUCTION

Placenta accreta spectrum (PAS) is the abnormal adherence of the placenta to the uterine myometrium and is a term used to describe placenta accreta, increta and percreta[1]. Placenta accreta occurs when the placenta adheres to the myometrium without invasion, placenta increta occurs when placental villi invade the myometrium, and placenta percreta occurs when placental villi invade through the myometrium into the serosa and villi may also invade adjacent structures, including the bladder. The loss of the normal myometrial architecture following surgery allows the extravillous trophoblast to reach and contribute to the transformation of maternal vasculature under the scar area, which is clinically responsible for the high hemorrhagic risk observed in women with PAS[2–6]. PAS is associated with a very high risk of maternal mortality and morbidity, including severe hemorrhage, hysterectomy and urinary tract injury, with significantly increased risk among patients who are undiagnosed before delivery[1,6,7]. Previous uterine procedures such as Cesarean delivery, myomectomy, uterine curettage and endometrial ablation are known PAS risk factors[1,7,8].

Ultrasound is the primary imaging modality to identify PAS in women at risk, while magnetic resonance imaging is used less frequently because of limited access and higher cost, but may be useful in particular clinical scenarios, such as in women with a posterior placenta[9,10], when an ultrasound examination is inconclusive. Several ultrasound signs for PAS have been reported, but the optimal combination of markers to identify PAS remains undetermined[9]. PAS is most commonly diagnosed in the second or third trimester[1]. However, several studies have investigated the sensitivity and specificity of first-trimester ultrasound markers for diagnosis of PAS[9,11]. Accurate prenatal diagnosis of PAS is essential to allow surgical planning, coordinate multidisciplinary care and enable transfer of care to a tertiary center; it has also been demonstrated to improve patient outcome[9].

We performed a systematic review and meta-analysis to investigate the accuracy of first-trimester ultrasound examination in detecting PAS and to compare its diagnostic performance with that reported in the second and third trimesters of pregnancy.

METHODS

This systematic review and meta-analysis was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist[12]. The study protocol for this systematic review was registered in the PROSPERO international prospective register of systematic reviews before data collection (registration number: CRD42023410813).

Search strategy

Two independent authors (K.H. and A.H.N.) conducted a literature search using PubMed, Web of Science and EMBASE from inception until 10 March 2023. The search, conducted from 8 March to 10 March 2023, had no language restrictions and employed the following keywords: ('accreta'(TIAB) OR 'increta'(TIAB) OR 'percreta'(TIAB) OR 'invasive placen*'(TIAB) OR 'adherent placen*'(TIAB)) AND ('ultrasound'(TIAB) OR 'ultrasonography'(TIAB) OR 'imaging'(TIAB) OR 'doppler'(TIAB) OR 'sonograph'(TIAB)). In addition, the references of included articles were reviewed manually to identify potential additional studies for inclusion. Study selection was carried out by two independent authors (K.H. and A.H.N.), with any discrepancies resolved through consultation with a third investigator (A.Z.A.).

Eligibility criteria

We included cohort, case–control and cross-sectional studies that reported on the accuracy of ultrasound in predicting PAS in singleton pregnancies based on various sonographic parameters and provided the necessary information to generate 2×2 tables. Studies were eligible if they met the following criteria: (1) the study involved ultrasound examination during the first trimester ($\leq 13+6$ weeks), second trimester ($14+0$ to $27+6$ weeks) and third trimester ($\geq 28+0$ weeks) in pregnancies with one or more risk factors for PAS, such as a previous Cesarean delivery, other uterine surgery or presence of placenta previa or a low-lying placenta; (2) the study provided the number of true-positive, false-positive, true-negative and false-negative cases, as well as sensitivity and specificity values. Studies were excluded if they: (1) did not provide complete information for cases with suspected PAS and/or authors did not respond when contacted for further information; (2) were case series or reports, editorials, comments, reviews or letters without original data; or (3) included multiple gestations. Diagnosis of PAS was made through clinical observation of unusual placental attachment, signs of deep invasion into the uterus during surgery (surgical diagnosis) and/or microscopic analysis of trophoblast invasion through the myometrium with an absence of normal decidua at the basal plate (pathological diagnosis).

Data extraction

Data were extracted from the included studies using a predesigned form that captured information on study characteristics (e.g. first author name, study design,

prospective or retrospective data collection, year of publication), patient characteristics (inclusion criteria, sample size, demographic characteristics), details of the ultrasound examination (trimester and sonographic markers used for PAS detection) and reference-standard outcome (surgical, pathological or both) assessed.

For each study and for all cut-off values defining an abnormal ultrasound result (presence of at least one sonographic sign suggestive of PAS), we extracted the number of true-positive, false-positive, true-negative and false-negative test results. When predictive accuracy data were not available, we recalculated them from the reported results.

Outcome measures

The primary outcomes were the sensitivity, specificity, diagnostic odds ratio, likelihood ratios and area under the receiver-operating-characteristics (ROC) curve (AUC) of first-trimester ultrasound for the detection of PAS, defined as the presence of at least one ultrasound marker of PAS. Secondary analyses were conducted to assess the accuracy of different ultrasound markers during each trimester of pregnancy (first, second/third). The included ultrasound markers were as follows: presence of abnormal placental lacunae (defined as irregular hypoechogenic spaces containing turbulent flow), loss of retroplacental clear zone, irregularity (interruption) at the uterovesical interface, myometrial thinning < 10 mm, placental bulging and uterovesical or lower uterine hypervascularity (a striking amount of color Doppler signal seen between the myometrium and posterior wall of bladder). Two subgroup analyses were conducted to evaluate the diagnostic accuracy of ultrasound in detecting PAS: (1) including only studies that used histopathological confirmation of PAS as the reference standard; and (2) excluding studies with high risk of bias according to Quality Assessment of Diagnostic Accuracy Studies-2 (QUADAS-2) assessment.

Assessment of risk of bias

Risk of bias in each included study was evaluated using a modified version of the QUADAS-2 tool[13]. QUADAS-2 consists of 'patient selection', 'index test', 'reference standard' and 'flow and timing' domains for risk of bias, and 'patient selection', 'index test' and 'reference standard' domains for applicability concerns. Each item was scored as having a high, low or unclear risk of bias. Three authors (K.H., A.H.N. and D.D.M.) assessed independently the methodological quality, using a standard form with quality assessment criteria and a flow diagram; disagreements were resolved by discussion to reach a consensus. The authors determined the risk of selection bias based on the description of the inclusion and exclusion criteria of the studies. The description of the technique for detecting PAS antenatally in studies was assessed to classify the index-test domain. For evaluation of the reference-standard domain, the method used to determine the presence of PAS was assessed (intraoperative or histopathological). For evaluation of the flow-and-timing domain, the description of the time elapsed between the index-test assessment and the reference-standard result was evaluated.

Statistical analysis

For each meta-analysis, we computed summary estimates of sensitivity, specificity, positive and negative likelihood ratios and diagnostic odds ratio using the hierarchical summary ROC (HSROC) model. Rutter and Gatsonis HSROC parameterization was used because it models functions of sensitivity and specificity to define a summary ROC curve, and its hierarchical modeling strategy can be used for comparisons of test accuracy when there is variability in threshold between studies. However, when the number of studies is small, the uncertainty associated with the estimation of the shape parameter could be very high, and models may fail to converge. Hence, for all meta-analyses in which fewer than four study estimates could be pooled, the DerSimonian–Laird random-effects model was used. Statistical analysis was performed using STATA 17.0 (StataCorp., College Station, TX, USA).

RESULTS

Study selection and characteristics

Our search strategy identified 1235 unique studies for screening. A total of 37 studies, including 5764 pregnancies at high risk of PAS, met our inclusion criteria and were therefore included in the analysis[14–50] (Figure 1).

The included studies were published between 2008 and 2022. Among them, 21 studies were prospective in design, while 16 studies were retrospective. Five studies conducted ultrasound examinations during the first trimester (< 14 weeks), and 32 studies performed ultrasound examinations at or after 14 weeks of gestation. Twenty-five studies included only patients with suspected placenta previa or low-lying placenta during the antenatal period. The remaining 12 studies focused on patients with at least one clinical risk factor for PAS, including previous Cesarean delivery, uterine surgery or abnormal placentation (placenta previa/low-lying placenta).

Among the 5764 participants with risk factors for PAS who underwent ultrasound examinations, 1397 women were identified as having suspected placenta previa or low-lying placenta (placental edge is 0–20 mm from the edge of the internal cervical os) during the antenatal period. PAS was diagnosed in 1348 cases based on histopathological analysis and/or intraoperative surgical findings. Detailed information regarding the characteristics of the included studies and their specific inclusion/exclusion criteria can be found in Table S1.

The quality assessment findings of the included studies using QUADAS-2 are summarized in Table S2. Fifteen studies had at least one domain at high risk of bias. Seven studies had high risk of bias for patient selection[14–20], three studies had high risk in the reference-standard

domain[21–23], four studies were high risk for flow and timing of the study[24–27] and one study had high risk for the index test[30].

Synthesis of results

Diagnostic accuracy of overall ultrasound (first vs second/third trimester)

First-trimester ultrasound demonstrated an overall sensitivity of 86% (95% CI, 78–92%), specificity of 63% (95% CI, 55–70%) and an AUC of 0.83 (95% CI, 0.80–0.86) for the detection of PAS (Table 1, Figure 2). Second-/third-trimester ultrasound demonstrated an overall sensitivity of 88% (95% CI, 84–91%), specificity of 92% (95% CI, 85–96%) and an AUC of 0.94 (95% CI, 0.92–0.96) (Table 1, Figure 3).

The subgroup analysis based on studies using histopathological PAS confirmation showed that first-trimester ultrasound had a sensitivity of 86% (95% CI, 78–92%) and specificity of 63% (95% CI, 55–70%), with an AUC of 0.83 (95% CI, 0.80–0.86) (Figure S1). For the second/third trimester, sensitivity was 88% (95% CI, 82–92%), specificity was 91% (95% CI, 82–95%) and the AUC was 0.94 (95% CI, 0.91–0.96) for detecting PAS (Figure S1). After excluding studies with high risk of bias, the results remained similar, with first-trimester ultrasound showing a sensitivity of 86% (95% CI, 78–92%) and specificity of 63% (95% CI, 55–70%), with an AUC of 0.83 (95% CI, 0.80–0.86) (Figure S2). In the second/third trimester, ultrasound had

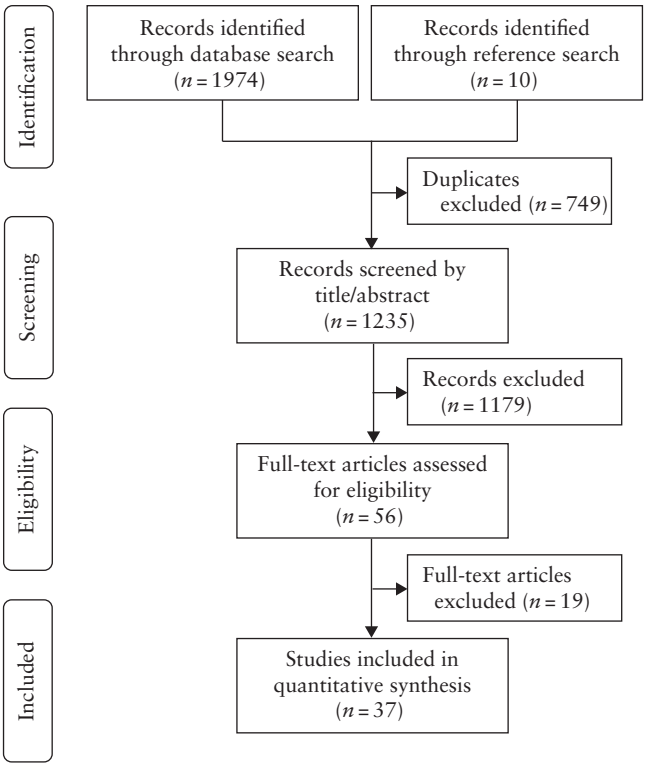

Figure 1 PRISMA flowchart summarizing inclusion of studies in systematic review and meta-analysis.

Table 1 Diagnostic accuracy measures of sonographic markers for placenta accreta spectrum, according to trimester of pregnancy

	Sensitivity		*Specificity*		*LR+*		*LR−*		*DOR*	
Ultrasound marker	*First trimester*	*Second/third trimester*	*First trimester*	*Second/third trimester*	*First trimester*	*Second/third trimester*	*First trimester*	*Second/third trimester*	*First trimester*	*Second/third trimester*
Lacunae	0.80 (0.51–0.94)	0.73 (0.64–0.81)	0.78 (0.72–0.83)	0.86 (0.76–0.92)	3.65 (2.35–5.69)	4.70 (2.77–7.97)	0.25 (0.08–0.77)	0.32 (0.23–0.44)	14 (3–65)	15 (7–30)
Loss of clear zone	0.84 (0.76–0.90)	0.80 (0.72–0.86)	0.87 (0.81–0.92)	0.89 (0.80–0.95)	31.2 (0.5–2054.5)	7.1 (3.7–13.5)	0.16 (0.09–0.28)	0.24 (0.17–0.33)	198 (2–15 679)	30 (14–66)
Uterovesical interface irregularity	0.40 (0.20–0.64)	0.36 (0.28–0.46)	0.99 (0.96–1.00)	0.99 (0.97–1.00)	43.8 (8.2–234.1)	43.3 (12.4–151.6)	0.61 (0.41–0.90)	0.64 (0.56–0.73)	72 (11–469)	68 (19–236)
Myometrial thinning	0.85 (0.70–0.93)	0.65 (0.49–0.79)	0.96 (0.38–1.00)	0.93 (0.83–0.97)	23.3 (0.7–797.9)	8.2 (3.7–18.0)	0.16 (0.08–0.32)	0.39 (0.26–0.57)	148 (4–5514)	21 (9–51)
Lower uterine hypervascularity	0.97 (0.19–1.00)	0.49 (0.35–0.64)	0.97 (0.74–1.00)	0.97 (0.93–0.99)	NA	16.5 (6.7–40.9)	NA	0.53 (0.41–0.70)	NA	31 (12–82)
Placental bulging	NA	0.21 (0.10–0.37)	NA	0.99 (0.95–1.00)	NA	21.5 (4.0–114.3)	NA	0.80 (0.68–0.93)	NA	27 (5–147)
Overall ultrasound	0.86 (0.78–0.92)	0.88 (0.84–0.91)	0.63 (0.55–0.70)	0.92 (0.85–0.96)	2.3 (1.9–2.9)	11.2 (6.1–20.5)	0.22 (0.13–0.36)	0.13 (0.10–0.18)	11 (5–21)	86 (44–168)

Data in parentheses are 95% CI. DOR, diagnostic odds ratio; LR+, positive likelihood ratio; LR−, negative likelihood ratio; NA, not available.

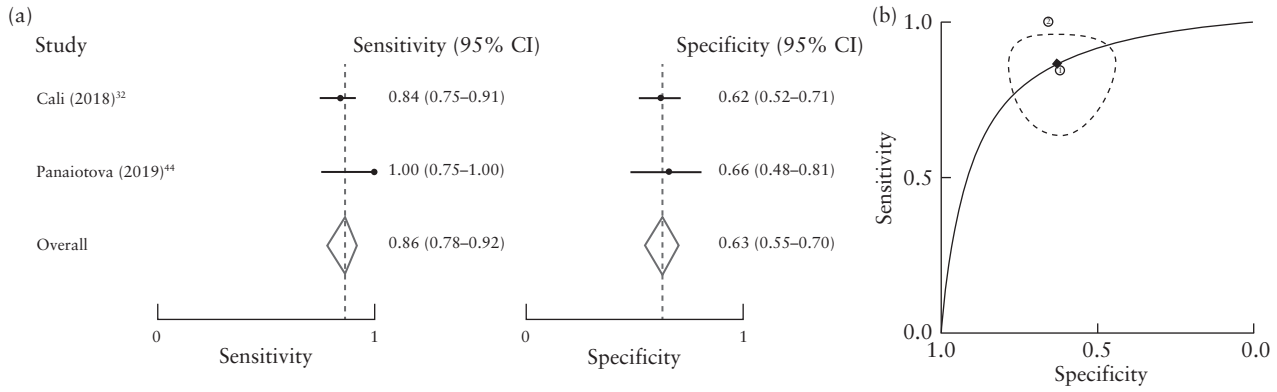

Figure 2 (a) Forest plots showing sensitivity and specificity of first-trimester ultrasound for detection of placenta accreta spectrum. Only first author is given for each study. (b) Corresponding summary receiver-operating-characteristics curve. ○, observed data; ◆, summary operating point; - - - -, 95% confidence contour.

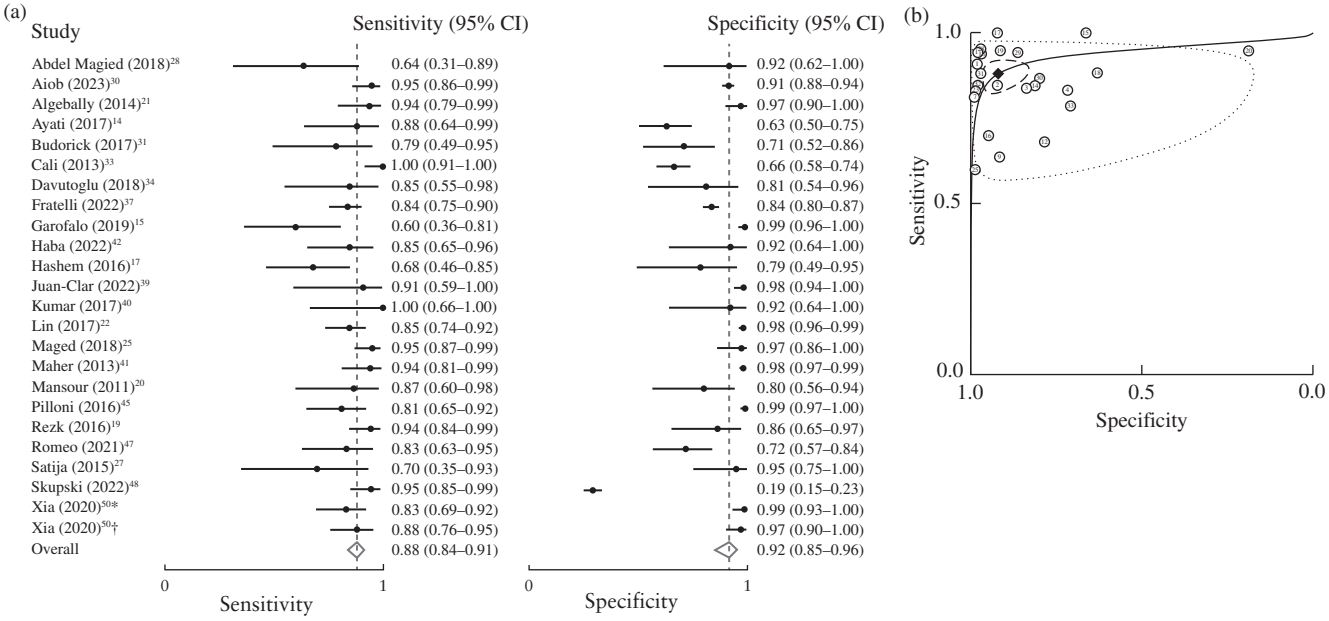

Figure 3 (a) Forest plots showing sensitivity and specificity of second/third-trimester ultrasound for detection of placenta accreta spectrum. Only first author is given for each study. *Third-trimester ultrasound. †Second-trimester ultrasound. (b) Corresponding summary receiver-operating-characteristics curve. ○, observed data; ◆, summary operating point; – – –, 95% confidence contour; ·····, 95% prediction contour.

a sensitivity of 88% (95% CI, 83–91%), specificity of 90% (95% CI, 77–96%) and an AUC of 0.92 (95% CI, 0.90–0.94) for detecting PAS (Figure S2).

Diagnostic accuracy of each sonographic marker (first vs *second/third trimester)*

Regarding the diagnostic accuracy of individual sonographic markers according to trimester of pregnancy, placental lacunae demonstrated a sensitivity of 80% (95% CI, 51–94%) and specificity of 78% (95% CI, 72–83%) in the first trimester, and a sensitivity of 73% (95% CI, 64–81%) and specificity of 86% (95% CI, 76–92%) in the second/third trimester (Figure S3). Loss of retroplacental clear zone had a sensitivity of 84% (95% CI, 76–90%) in the first trimester and 80% (95% CI, 72–86%) in the second/third trimester, with specificities of 87% (95% CI, 81–92%) and 89% (95% CI, 80–95%), respectively (Figure S4).

Uterovesical interface irregularity (interruption) exhibited a sensitivity of 40% (95% CI, 20–64%) in the first trimester and 36% (95% CI, 28–46%) in the second/third trimester, with a specificity of 99% (95% CI, 96–100%) in the first trimester and 99% (95% CI, 97–100%) in the second/third trimester (Figure S5). Thin myometrial thickness (< 10 mm) showed a sensitivity of 85% (95% CI, 70–93%) in the first trimester and 65% (95% CI, 49–79%) in the second/third trimester, while exhibiting specificities of 96% (95% CI, 38–100%) and 93% (95% CI, 83–97%), respectively (Figure S6). Furthermore, lower uterine hypervascularity had a sensitivity of 97% (95% CI, 19–100%) in the first trimester and 49% (95% CI, 35–64%) in the second/third trimester, with specificities of 97% (95% CI, 74–100%) and 97% (95% CI, 93–99%), respectively (Figure S7).

Due to the limited number of studies reporting data on placental bulging ('deviation of external uterine contour from expected plane caused by abnormal outward bulge of placental tissue'[51]) during the first trimester, we could estimate the diagnostic measures of this marker only during the second/third trimester, which revealed a sensitivity of 21% (95% CI, 10–37%) and specificity of 99% (95% CI, 95–100%) (Figure S8).

DISCUSSION

The findings of this systematic review and meta-analysis indicate that first-trimester ultrasound demonstrates a high diagnostic accuracy for the detection of PAS among pregnancies at high risk of PAS. First-trimester ultrasound for the detection of PAS demonstrated similar sensitivity and specificity compared with second-/third-trimester ultrasound. Lower uterine hypervascularity and myometrial thinning demonstrated the highest sensitivity for PAS detection in the first trimester. First-trimester evaluation yielded an AUC of 0.83 and second-/third-trimester evaluation had an AUC of 0.94 for PAS detection.

PAS represents a continuum of complex placental disorders characterized by significant maternal morbidity and mortality. Several research groups have demonstrated that multidisciplinary team-based care and coordination improve overall outcomes[52–54]. The single greatest limitation to care remains the detection rate of PAS. Whereas sonography remains the reference standard for detecting PAS and subsequent referral for tertiary care, ~ 50% of cases remain undiagnosed before delivery[55,56]. Identification of PAS during the first trimester has several advantages. First, it enables patients to receive timely counseling about potential complications, leading to more informed reproductive decisions. Additionally, it allows clinicians sufficient time for surgical planning and transfer of care to a specialized multidisciplinary center for managing complex pregnancies. It is important to note that, although the use of first-trimester ultrasound for PAS detection offers these benefits, it should not replace the evaluation in the second or third trimester. We recommend that first-trimester ultrasound should complement the existing diagnostic approach. Incorporating first-trimester ultrasound assessment for PAS markers into current practice holds the potential to reduce maternal and fetal morbidity and mortality, which is the ultimate goal for the timely management of pregnancies with PAS.

Table 1 demonstrates the overall trend of sensitivity and specificity of ultrasound markers in the first trimester compared with the second/third trimester. Most ultrasound markers show similar specificity between the first and second/third trimester, but the majority display higher sensitivity during the first trimester than in the second/third trimester. This emphasizes the significance of screening for all PAS markers during the first trimester, as their presence becomes less sensitive in the later stages of pregnancy.

The findings of our study should be considered in the context of its strengths and limitations. After vigorous assessment, a large number of studies were included, allowing for comprehensive analysis of individual findings and subcategorization by pregnancy trimester. Although a detailed bias analysis was performed, the nature of PAS reports is often not reflective of generalized care, as studied patients are assessed at large referral centers, and previous stratification of PAS risk is performed based on historical risk factors such as placenta previa, number of Cesarean sections and *in-vitro* fertilization. Another limitation of the present review lies in the inclusion of studies with different reference standards. PAS is commonly confirmed at surgical or histopathological examination. However, surgical assessment tends to overdiagnose PAS, whereas pathological assessment is a retrospective diagnosis, which cannot be applied prospectively before surgery.

Furthermore, the current systematic review faced a limitation regarding the variation in ultrasound indicators examined across the included studies. Moreover, a significant proportion of the studies investigating the predictive accuracy of ultrasound in detecting PAS did not provide information on the diagnostic performance of first-trimester ultrasound in assessing the severity and depth of PAS invasion. Therefore, future research is encouraged to explore whether first-trimester ultrasound can predict effectively the severity of this condition. Moreover, the primary synthesis of results regarding the sensitivity and specificity of PAS detection in the first trimester included only two studies, which may limit our ability to draw solid conclusions. Finally, the issue of determining the specific gestational-age range during ultrasound examinations is crucial. Although we categorized the ultrasound scans into pregnancy trimesters, the absence of precise gestational-age information prevented us from conducting a stratified analysis based on the timing of assessment. This is particularly important because PAS is a progressive condition, and it is plausible that the ultrasound appearance of different indicators of PAS can change or evolve throughout pregnancy. In light of these limitations, the scarcity of studies that differentiated between second- and third-trimester ultrasound examinations led us to combine studies conducting ultrasound examinations after 14 weeks of gestation into a single group representing the second/third trimester.

In conclusion, the findings of this systematic review and meta-analysis demonstrate that first-trimester ultrasound has a high diagnostic accuracy in detecting PAS in pregnancies with risk factors. Early identification of PAS in the first trimester enables patients to receive timely counseling about potential complications and empowers them to make informed decisions. Additionally, it allows healthcare professionals to plan adequately for surgical interventions and facilitate the transfer of patients to specialized PAS centers that possess the necessary expertise to manage these complex pregnancies. Future studies aimed at assessing whether first-trimester diagnosis of PAS improves maternal and neonatal outcomes are needed before widespread introduction of first-trimester screening programs for PAS in clinical practice.

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SUPPORTING INFORMATION ON THE INTERNET

The following supporting information may be found in the online version of this article:

Table S1 Characteristics of included studies

Table S2 Quality assessment of studies included in systematic review and meta-analysis, according to Quality Assessment of Diagnostic Accuracy Studies-2 (QUADAS-2) tool

Figure S1 Forest plots showing sensitivity and specificity of ultrasound for detection of placenta accreta spectrum in first and second/third trimesters on subgroup analysis including only studies with histopathological confirmation. Only first author is given for each study.

Figure S2 Forest plots showing sensitivity and specificity of ultrasound for detection of placenta accreta spectrum in first and second/third trimesters on subgroup analysis excluding studies with high risk of bias. Only first author is given for each study.

Figure S3 Forest plots showing sensitivity and specificity of placental lacunae for detection of placenta accreta spectrum on ultrasound in first and second/third trimesters. Only first author is given for each study.

Figure S4 Forest plots showing sensitivity and specificity of loss of retroplacental clear zone for detection of placenta accreta spectrum on ultrasound in first and second/third trimesters. Only first author is given for each study.

Figure S5 Forest plots showing sensitivity and specificity of uterovesical interface irregularity for detection of placenta accreta spectrum on ultrasound in first and second/third trimesters. Only first author is given for each study.

Figure S6 Forest plots showing sensitivity and specificity of thin myometrial thickness for detection of placenta accreta spectrum on ultrasound in first and second/third trimesters. Only first author is given for each study.

Figure S7 Forest plots showing sensitivity and specificity of lower uterine hypervascularity for detection of placenta accreta spectrum on ultrasound in first and second/third trimesters. Only first author is given for each study.

Figure S8 Forest plots showing sensitivity and specificity of placental bulging for detection of placenta accreta spectrum on ultrasound in second/third trimester. Only first author is given for each study.