Accuracy of Ultrasound vs. Magnetic Resonance Imaging in Diagnosing Placenta Accreta Spectrum: A Systematic Review

Mashail Ali S. Alomari [1], Alaa Rashed AlQarni [2], Reham Yahya Alogran [2], Sara Mohssin Fageeh [2], Hussain M Assiri [3]

1. Maternal-fetal Medicine Fellow, SCFHS, Saudi Arabia
2- OB/GYN Resident, MOH, Saudi Arabia
3- OB/GYN Consultant, MOH, Saudi Arabia

Corresponding author:
Dr. Mashail Ali S. Alomari
Email: mashailalomari@gmail.com

Received: November 2024. Accepted: December 2024; Published: January / February, 2025.
Citation: Mashail Ali S. Alomari et al. Accuracy of Ultrasound vs. Magnetic Resonance Imaging in Diagnosing Placenta Accreta Spectrum: A Systematic Review. World Family Medicine. January/February 2025; 23(1): 40-45.
DOI: 10.5742/MEWFM.2025.95257877

Abstract

Aim of Study: To assess the clinical value of MRI for the diagnosis of placenta accreta by systematic review of published related diagnostic studies.

Methods: An exhaustive electronic search was conducted based on the relevant terms and MeSH (Medical Subject Headings of the National Library of Medicine) descriptors in PubMed, Embase, and Ovid databases. The literature screening process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Results: A total of 108 records were identified through database searching. After applying the inclusion and exclusion criteria, only seven records could be included. Two studies followed a prospective research design, while the other five studies followed a retrospective research design. The sensitivity and specificity of ultrasonography and MRI, both separately and combined for the diagnosis of placenta previa complicated with placenta accreta, were shown in each included study.

Conclusions: Ultrasonography is more sensitive and also more specific than MRI for the diagnosis of placenta previa complicated with placenta accreta. Ultrasound combined with MRI produces higher accuracy and sensitivity than ultrasound alone or MRI alone in the diagnosis of placenta previa with placenta accreta.

Key Words: Placenta Accreta Spectrum, Ultrasonography, Magnetic Resonance Imaging, Sensitivity, Specificity, Systematic Review.

Introduction

Placenta accreta (PA) is one of the serious complications of pregnancy, where the placenta does not spontaneously separate after delivery and cannot be forcibly separated without causing catastrophic obstetric hemorrhage (1). It is caused by abnormal placental implantation over a myometrial scar, and results in the extrusion of placental tissue beyond the usual confines of the intrauterine cavity with fibrinoid deposition, and massive neovascularity (2).

The spectrum of PA describes the abnormal attachment of placental trophoblasts to the myometrium. According to the depth of the invasion into the myometrium, it is further graded according to the extent of placenta involvement into: placenta accreta (PA), with abnormal adherence to the myometrium, placenta increta (PI), with deep myometrial implantation, or placenta perforata (PP), when it breaches the serosal surface or involves other surrounding structures. The main risk factors for PA include advanced maternal age, scarred uterus, and uterine lesions (3).

With the worldwide increase in abortion and Cesarean section (CS) rates, the incidence of PA has shown an increasing trend. However, about 50-60% of PA is not diagnosed antenatally (4). The primary pathophysiological mechanism of PA may be related to several factors, e.g., basal decidua loss, abnormal local oxygen tension, excessive trophoblast invasion, and abnormal vascular remodeling (5).

In PA, the placenta can be detached if there is sufficient myometrium underlying the placenta that enables adequate uterine contractions to prevent severe hemorrhage. However, in PI and PP, any attempt to manually remove the placenta may cause uterine rupture and heavy bleeding (6).

Placenta accreta is associated with a very high risk of maternal mortality, especially if the surgeon is caught unaware. In resource-limited settings, it is likely that women with PA have a much greater risk of death due to technical, diagnostic, logistic, and resourcing inadequacies (7). Studies have shown that the perinatal mortality of PA is about 7% (8).

The early diagnosis of PA is essential for decreasing maternal mortality or morbidity. Doppler ultrasound is the primary imaging technique for diagnosing PA, thanks to its non-invasiveness, economic advantage, and wide availability. However, its diagnostic yield for PA is adversely influenced by amniotic fluid, intestinal gas, and placental position (9). In recent years, magnetic resonance imaging (MRI) has been increasingly adopted in the diagnosis of prenatal placental implantation in the realization of its advantages of high-resolution, multiangle imaging, and limited influence by amniotic fluid and intestinal gas (10).

Previous literature has reported different diagnostic accuracies of MRI for PA with inconsistent sensitivity and specificity. Therefore, this study aimed to assess the clinical value of MRI for the diagnosis of PA by systematic review of published related diagnostic studies.

Materials and methods

Several inclusion and exclusion criteria were considered to retrieve a study in this systematic review. The accepted research designs were prospective, randomized controlled trials (RCTs) or a comparative cohort study.

An exhaustive electronic search was conducted based on the following combined relevant terms and MeSH (Medical Subject Headings of the National Library of Medicine) descriptors in the PubMed, Embase, and Ovid databases. The search was based on the following: (“placenta accreta” OR “Accreta, placenta” OR “placenta increta” OR “placenta percreta”) AND (“MRI”, “magnetic resonance imaging”) AND (“diagnosis” OR “diagnostic accuracy” OR “sensitivity” OR “specificity”). The literature screening process is shown in Figure (1) according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (11).

Inclusion and exclusion criteria

The references of the identified articles were also searched. The search was limited to articles published in English during the period from January 2020 to January 2023). Only studies that included both ultrasound and MRI diagnostic measures for PA were included. On the other hand, studies published in the form of a letter to the editor or comments, meta-analyses, or review articles, were excluded.

This systematic review was conducted in line with the protocol agreed upon by all authors. Two reviewers (MA and AA) independently assessed the quality of studies using the Newcastle–Ottawa Scale quality assessment tool for observational studies (12). To reach a consensus, all different opinions about quality assessment were discussed with a third reviewer (HA).

Results and Discussion

A total of 108 records were identified through database searching. However, after applying the inclusion and exclusion criteria, only seven records could be included.

Two of the included studies followed a prospective research design (13-14), while the other five studies followed a retrospective research design (15-19).

The sensitivity and specificity of ultrasonography and MRI, both separately and combined for the diagnosis of placenta previa complicated with placenta accreta, were sought in each included study. The results are shown in Table (1).

The sensitivity of ultrasonography ranged from 78% (14) to 96% (13). On the other hand, the specificity of ultrasonography ranged from 60% (13) to 91.78% (15). Moreover, the area under the curve (AUC) was reported by only one study, An et al., (16) to be 0.858.

The sensitivity of MRI ranged from 62% (18) to 94.4% (18). On the other hand, the specificity of MRI ranged from 40% (13) to 87.67% during the second trimester (15). Moreover, the area under the curve (AUC) was reported by only one study, An et al. (16) to be 0.709.

Regarding the combined yield of ultrasound with MRI, their combined sensitivity for the diagnosis of placenta previa complicated with placenta accreta ranged from 94.67% (19) to 97.78% (14). On the other hand, their combined specificity ranged from 72% (14) to 87.88% (19). Moreover, the area under the curve (AUC) was reported by only one study, An et al. (16) to be 0.931.

Conclusions

Ultrasonography is more sensitive and also more specific than MRI for the diagnosis of placenta previa complicated with placenta accreta. Ultrasound combined with MRI produces higher accuracy and sensitivity than ultrasound alone or MRI alone in the diagnosis of placenta previa with placenta accreta.

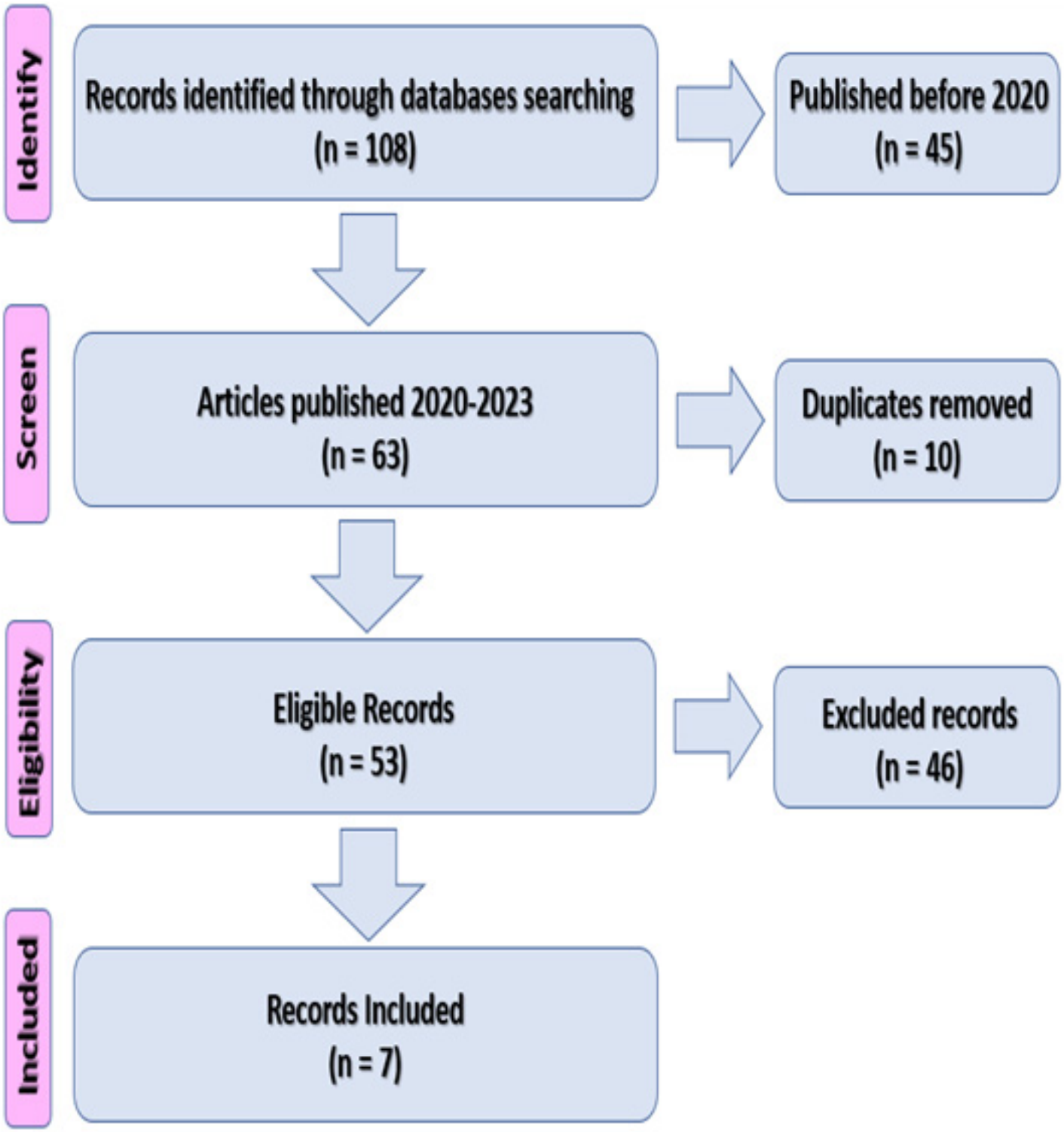

Figure 1: PRISMA flow chart for the search process

Table 1: Summary of the main results

Authors	Study design	No. of Participants	US	MRI	Combined	Conclusion
Barzilay et al. [13]	Prospective	28	Sen: 96% Sp: 60%	Sen: 83% Sp:40%	---	US is more sensitive and specific than MRI
Xia et al. [15]	Retrospective	86 cases, 46 in the 2nd trimester and 40 in the 3rd trimester	Sen: 95.65% (2nd trimester), and 97.50% in the 3rd trimester) Sp: 91.78% (2nd trimester), and 90.70% (in the 3rd trimester)	Sen: 89.13% (2nd trimester), and 92.50% in the 3rd trimester) Sp: 87.67% (2nd trimester), and 87.21% (in the 3rd trimester)	---	Abdominal US and MRI for PA in the 2nd and 3rd trimesters provide meaningful imaging evidence
An et al. [16]	Retrospective	132 women with PA	AUC: 0.858	AUC: 0.709	AUC: 0.931	US/MRI-based signature is a powerful predictor for the degree of PA spectrum
Guo et al. [14]	Prospective	70	Sen: 77.78% Sp: 68%	---	Sen: 97.78% Sp: 72%	Compared with ultrasound or MRI alone, ultrasound combined with MRI has higher accuracy and sensitivity in the diagnosis of placenta previa with placenta accreta, along with lower false positive diagnosis rates
Thiravit et al. [17]	Retrospective	62 cases	Sen: 91.7% Sp: 76.9%	Sen: 94.4% Sp: 84.6%	---	Placental bulge
Pain et al. [18]	Retrospective	82 women with PA	Sen: 55% Sp: 68%	Sen: 62% Sp: 72%		Loss of the normal retro-placental clear space had the highest sensitivity
Zhang and Dong [19]	Retrospective	108	Sen: 88% Sp: 66.67%	Sen: 92% Sp: 72.73%	Sen: 94.67% Sp: 87.88%	Combining prenatal US score of the placenta with MRI plays an important role in the diagnosis of placenta accreta during the 2nd and 3rd trimesters.

References

1. Morlando M, Collins S. Placenta accreta spectrum disorders: challenges, risks, and management strategies. Int J Women's Health. 2020; 12:1033-1045. doi:10.2147/IJWH.S224191.
2. Jauniaux E, Hussein AM, Elbarmelgy RM, Elbarmelgy RA, Burton GJ. Failure of placental detachment in accreta placentation is associated with excessive fibrinoid deposition at the utero-placental interface. Am J Obstet Gynecol. 2022; 226:243.e1-243.e10. doi:10.1016/j.ajog.2021.08.026.
3. Jauniaux E, Ayres-de-Campos D, J. Langho-Roos et al. FIGO classification for the clinical diagnosis of placenta accreta spectrum disorders. International Journal of Gynecology & Obstetrics, 2019; 146(1): 20–24.
4. Mulla BM, Weatherford R, Redhunt AM. et al. Hemorrhagic morbidity in placenta accreta spectrum with and without placenta previa. Archives of Gynecology and Obstetrics, 2019; 300(6): 1601–1606.
5. Carusi DA. The placenta accreta spectrum: epidemiology and risk factors. Clinical Obstetrics and Gynecology, 2018; 61(4):733–742.
6. Battaglia FC, Meschia G. Review of studies in human pregnancy of uterine and umbilical blood flows. Med Wieku Rozwoj. 2013; 17:287-292.
7. Adu-Bredu TK, Rijken MJ, Nieto-Calvache AJ, Stefanovic V, Aryananda RA, Fox KA, et al. A simple guide to ultrasound screening for placenta accreta spectrum for improving detection and optimizing management in resource limited settings. Int J Gynecol Obstet. 2023; 160:732–741.
8. Baughman WC, Corteville JE, Shah RR. Placenta accreta: spectrum of US and MR imaging findings. Radiographics, 2008; 28(7): 1905–1916.
9. Esako TF, Sparks TN, Kaimal AJ, et al. Diagnosis and morbidity of placenta accreta. Ultrasound in Obstetrics & Gynecology, 2011; 37(3): 324–327.
10. Lin H, Li L, Lin Y, Wang W. Accuracy of Magnetic Resonance Imaging in Diagnosing Placenta Accreta: A Systematic Review and Meta-Analysis. Computational and Mathematical Methods in Medicine Volume 2022, Article ID 2751559, 10 pages Doi: 10.1155/2022/2751559.
11. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.
12. Luchini C, Stubbs B, Solmi M, Veronese N. Assessing the quality of studies in meta-analyses: Advantages and limitations of the Newcastle Ottawa Scale. World J Meta-Anal 2017; 5(4): 80-84 [DOI: 10.13105/wjma.v5.i4.80.
13. Barzilay E, Brandt B, Gilboa Y, Kassif E, Achiron R, Raviv-Zilka L et al. Comparative analysis of ultrasound and MRI in the diagnosis of placenta accreta spectrum. The Journal of Maternal-Fetal & Neonatal Medicine, 2020; DOI: 10.1080/14767058.2020.1846699.
15. Xia H, Ke S-C, Qian R-R, et al. Comparison between abdominal ultrasound and nuclear magnetic resonance imaging detection of placenta accreta in the second and third trimester of pregnancy. Medicine 2020; 99:2. Medi-99-e17908.pdf (nih.gov).
16. An P, Zhang J, Yang F, Wang Z, Hu Y, Li X. USMRI Features and Clinical Data-Based Model for Predicting the Degree of Placenta Accreta Spectrum Disorders and Developing Prediction Models. International Journal of Clinical Practice. Volume 2022, Article ID 9527412, 9 pages. DOI: 10.1155/2022/9527412.
17. Thiravit S, Ma K, Goldman I. Role of Ultrasound and MRI in Diagnosis of Severe Placenta Accreta Spectrum Disorder: An Intraindividual Assessment with Emphasis on Placental Bulge. AJR 2021; 217:1377–1389. doi.org/10.2214/AJR.21.25581.
18. Pain FA, Dohan A, Grange G, et al. Percreta score to differentiate between placenta accreta and placenta percreta with ultrasound and MR imaging. Acta Obstet Gynecol Scand. 2022; 101:1135–1145. DOI: 10.1111/aogs.14420.
19. Zhang J, Dong P. Clinical Utility of the Prenatal Ultrasound Score of the Placenta Combined with Magnetic Resonance Imaging in Diagnosis of Placenta Accreta during the Second and Third Trimester of Pregnancy.