

ROLE OF COLOR DOPPLER U/S AND MRI FOR DIAGNOSIS OF PLACENTA ACCRETA

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ABSTRACT

Background: The worldwide incidence of placenta accreta (PA) is rapidly rising, following the trend of increasing cesarean delivery. Antenatal diagnosis is highly desirable because outcomes are optimized when delivery occurs at a level III or IV maternal care facility before the onset of labor and with avoidance of placental disruption. The primary diagnostic modality for antenatal diagnosis is obstetric color Doppler ultrasonography (CDUS). Magnetic Resonance Imaging (MRI), although widely employed, has yet to clearly demonstrate a significant improvement in management, but it is expensive and requires expertise that is rarely available in most low-income countries and many medium income countries.

Objective: To evaluate and compare the accuracy of CDUS and MRI in the diagnosis of PA and to define the most relevant specific features that may predict placental invasion.

Patients and methods: A case control study was conducted at AL- Azhar University Hospitals during the interval between November 2017 and November 2020, total set of 50 patients in the third trimester of pregnancy with diagnosis of placenta accreta and at least one previous caesarean section (CS). Patients were equally divided into 2 groups; Group I: Control group diagnosed as PA by CDUS. Group II: Study group diagnosed as placenta accreta by CDUS and subjected to MRI. With inclusion and exclusion criteria, all included women was subjected to; history taking, physical examination, obstetric CDUS and MRI scan was added for Group II only to pick up features suggestive of PA.

Results: The sensitivity and specificity of CDUS were 100% and 72%, whereas the sensitivity and specificity of MRI were 76% and 52%, respectively, in their ability to diagnose PA. The highest sensitivity of individual CDUS and MRI markers in predicting PA were obliteration of the retroplacental clear space (63.6%) and focal interruption in the myometrial wall (73.7%), respectively.

Conclusion: Ultrasound imaging is the mainstay of screening for placenta accreta. MRI appears to be complementary to ultrasonography, especially when there are few ultrasound signs or if there is a suspicion for invasion into surrounding organs.

Keywords: Placenta accreta, Color Doppler Ultrasonography, MRI.

INTRODUCTION

It has been suggested that cesarean scar pregnancy represents a precursor of one of the different grades of PA disorders (*Timor-Tritsch et al., 2014*).

Maternal mortality and morbidity are reduced when women with PA disorders, deliver in a center of excellence by a multidisciplinary care team with

experience in managing the surgical risks and perioperative challenges presented by these disorders (*Silver et al., 2015*).

Irrespective of the imaging modality used, prenatal diagnosis of PAS disorders remains subjective, with accuracy depending on the experience of the operator, which has so far been limited by the rarity of the condition and the lack of

training programs similar to those existing for the screening of fetal aneuploidies and fetal anatomical defects, such as congenital heart defects (*Jauniaux et al., 2018*).

The primary diagnostic modality for antenatal diagnosis is obstetric ultrasonography. Features of accreta visible by ultrasonography may be present as early as the first trimester; however, most women are diagnosed in the second and third trimesters (*Eller et al., 2011*).

Different ultrasound imaging techniques have been used over the last 30 years to diagnosis PA disorders in the third trimesters of pregnancy, including grey-scale and color Doppler sonography (*Jauniaux et al., 2016*).

The combination of grey-scale and color Doppler imaging ultrasound markers is reported to have increased the sensitivity of ultrasound imaging to around 90% with negative predictive values ranging between 95% and 98% (*D'Antonio et al., 2013*).

The main MRI features of placenta accreta include abnormal uterine bulging, dark intraplacental bands on T2-weighted imaging, heterogeneous signal intensity within the placenta, disorganized placental vasculature (*Meng et al., 2013*).

The present work aimed to evaluate and compare the accuracy of CDUS and magnetic MRI in the diagnosis of placenta accreta and to define the most relevant specific features that may predict placental invasion.

PATIENTS AND METHODS

A prospective case control study was conducted at AL- Azhar University

Hospitals during the interval between November 2017 and November 2020. This study was approved by the Ethics Committee for Human Research at Faculty of Medicine, AL- Azhar University. Informed verbal consent was obtained from every participant. All the pregnant participants were in the third trimester of pregnancy.

Total set of 50 patients were recruited from inpatients with diagnosis of PA by CDUS and at least one previous caesarean section delivery. They were equally classified into 2 groups:

Group I (G I): Control group was formed of patients diagnosed as PA by CDUS.

Group II (G II): Study group diagnosed as PA by CDUS and MRI.

Inclusion criteria:

- Pregnant women with PA, with implantation on the lower uterine segment.
- Previous uterine surgery (e.g., cesarean section, myomectomy).

Exclusion criteria:

- Presence of medical disorders (diabetes, hypertension, epilepsy, etc.).
- Presence of metallic prosthesis (prosthetic valves, pacemakers, cochlear implants, or plates and screws).

Obstetric ultrasonography was first used to screen the placental tissue in a systematic fashion. In the presence of placental sonolucent lakes, examination was completed using superimposed color Doppler flow.

MRI scan was added only for GII to pick up features suggestive of PA. MRI

scans were performed on a Siemens Magnetom Avanto 1.5-T scanner. T2-weighted single-shot fast spin echo sequences acquired in the axial, sagittal, and coronal planes using the following parameters (TR 5000/TE 110 ms, echo train length 13-15, slice thickness 5-7 mm, gap 1-2 mm, Field of view 24-38 cm, excitations (NSA) 3 and matrix 304 x 512).

Statistical analysis: Preceded data were entered into the statistical package for the

social sciences software program, version 21 to be statistically analyzed (SPSS Inc., Chicago, Illinois, USA).

Data were summarized using means and SD for quantitative variables and using frequencies and percentages for qualitative ones. Comparison between groups was performed using Kruskal–Wallis and Mann–Whitney U tests for quantitative variables and the χ^2 - test for qualitative ones. P values less than 0.05 were considered statistically significant.

RESULTS

The demographic characteristics of the participants of G I showed; mean values were 29.3, 4.2, 3.4, 2.3, 1 for age, parity, cesarean deliveries, abortion, dilation and curettage respectively.

The demographic characteristics of the Group II showed; p values were

significant for number of cesarean deliveries, number of abortions and number of years from last CS. As regard age & parity the 2 groups are demographically similar (Table 1).

Table (1): The Demographic Characteristics of G I and G II

Parameters	G I N=25		G II N=25				
	Mean	SD	Range	Mean	SD	Range	P
Criteria							
Age	29.33	±4.89	20-38y	30.13	±5.24	20-39y	0.05
Parity	4.26	±1.25	2-7	3.72	±1.69	1-7	0.06
Cesarean deliveries	3.44	±0.82	2-5	3.05	±1.23	1-6	0.04
Abortions	2.37	±1.01	1-4	1.63	±1.10	0-4	0.01
Dilation and curettage	1.00	±0.67	0-2	2	±0.75	0-3	0.02
Myomectomies	1.02	±0.59	0-2	2.09	±0.93	1-4y	0.01
Last CS delivery	2.69	±1.04	1-5y	2.20	±1.39	0-6y	0.04

Clinical history of previous uterine surgery was 93.1 % of patients had cesarean section deliveries, 8.6 % of them had myomectomy and 50% of them had dilation and curettage.

Placenta was anteriorly situated in 74.1% of patients and posteriorly situated in 25.9% of them. In the demographic characteristics of the studied cases P

values were significant for number of CS, number of abortions, number of years from last abortion and number of years from last CS. As regard age and parity, the 2 groups were demographically similar.

Multiple findings were more common than a single isolated finding. On CDUS, obliteration of the retroplacental clear space was found in 63.6% Of cases, the

interruption of the posterior bladder wall–uterine interface in 54.5% of cases, decreased myometrial thickness in 54.5% of cases, presence of placental vascular

spaces in 18.2% of cases, and presence of hypervascularity of the interface between the uterine serosa and the bladder wall in 45.4% of cases (**Table 2**).

Table (2): Sensitivity, specificity, positive predictive value, and negative redictive value of ultrasonography diagnostic criteria for placenta accreta in both groups

Items	Sensitivity	Specificity	PPV	NPV	Accuracy
Loss of RCS	63.64	66.44	98.66	75.00	82.61
Loss of BUI	54.55	86.34	89.55	70.59	78.26
VL	18.18	97.12	94.56	57.14	60.87
Increased vascularity	45.45	91.67	83.33	64.71	69.57
Decreased MT	54.55	87.88	77.56	70.59	78.26

NPV, negative predictive value; PPV, positive predictive value; MT, myometrial thickness; RCS, retroplacental clear space; BUI, bladder uterine interface; VL, vascular lacunae.

In G II, the MRI features of patients showed that they had accreta: heterogeneous placental signal intensity was found in 63.64% , dark intraplacental bands in 45.5%, focal interruption in the myometrial wall in 72.73% of cases, uterine bulging in 27.3% of cases, and direct visualization of invasion of pelvic

structures in 9% of case. Focal interruption in the myometrial wall was found to have the highest sensitivity (73.7%) followed by heterogeneous signal intensity within the placenta (63.6%) and then dark intraplacental bands (45.5%) (**Tables 3**).

Table (3): Sensitivity, specificity, positive predictive value, and negative predictive value of MRI diagnostic criteria for placenta accreta in both groups

Items	Sensitivity	Specificity	PPV	NPV	Accuracy
Interruption in myometrial wall	73.73	89.44	85.88	80.30	86.96
Heterogeneous intensity	63.64	95.12	91.33	75.23	82.61
Dark intraplacental bands onT2	45.45	88.87	55.88	66.67	73.91
Uterine bulging	27.27	98.12	79.88	60.33	65.22
Invasion of pelvic structures	79.09	95.66	93.66	54.55	56.52

NPV, negative predictive value; PPV, positive predictive value

According to the operative findings and/or pathology, CDUS was found to provide true-positive results in 100% of

patients proved to be accreta cases. MRI provided true-negative results in 52% of patients (**Table 4**).

Table (4): Sensitivity, specificity, positive predictive value, and negative predictive value of ultrasound and MRI in this study

Items	Sensitivity	Specificity	PPV	NPV	Accuracy
Final CDUS	100	72	89.55	86.96	72.73
Final MRI	76	52	87.5	73.33	78.26

NPV, negative predictive value; PPV, positive predictive value; US, ultrasonography.

DISCUSSION

The present study was a prospective study included 50 pregnant women at 28 weeks of gestation or more, to determine the need for MRI in the radiological diagnosis of candidate cases for placenta accreta. Sensitivity and specificity of CDUS were 100% and 40%, whereas for MRI sensitivity and specificity were 76 and 52%, respectively, in their ability to diagnosis placenta accreta. This is in disagreement with a study performed in 2010, which stated that US had a sensitivity of 93% and specificity of 71% compared with MRI, which had a sensitivity of 80% and specificity of 65% (*Dwyer et al., 2010*).

Another comparable study confirmed that obstetric color Doppler ultrasonography is highly reliable to diagnose or exclude the presence of PA, and found MRI to be an excellent tool for the staging and topographic evaluation of PA. They stated that MRI and Doppler US show no statistical difference in identifying patients with PA, whereas MRI was statistically better than CDUS in characterizing the topography of invasion. MRI showed accuracy of 100% in assessing the depth of placental infiltration versus 75% by CDUS (*Masselli et al., 2010*).

A recent study by McLean et al. including a large cohort of gravid patients at risk for placenta accreta failed to demonstrate the incremental use of MRI for placenta accreta changes delivery mode in a stratified analysis. Such a study had performed MRI in a small proportion of the cohort that was only 28.7%, also being a retrospective study handles a

percentage of CDUS bias regarding analytical data (*McLean et al., 2011*).

Warshak et al. compared CDUS and postcontrast MRI performance in the diagnosis and evaluation of placenta accreta (*Warshak et al., 2016*). They reported on 39 cases of confirmed placenta accreta with an unpaired study design. Ultrasound had a sensitivity of 77% and specificity of 96%, and MRI with gadolinium enhancement had a sensitivity of 88% and specificity of 100%. The high statistical values in the aforementioned study may be because they had performed routine transvaginal ultrasound in addition to the transabdominal approach in evaluating their studied cases as well as gadolinium enhancement in their MRI examination, as according to them it had more clearly delineated the outer placental surface relative to the myometrium (*Lax et al., 2017*).

Our study agrees with the findings of *Lax et al (2017)*. We also found that the focal interruption in the myometrium was seen in 72.7%, abnormal heterogeneous signal intensity of the placenta was seen is 63.6%, dark intraplacental bands on T2 sequences was seen in 45.5% of the surgically/pathologically proved cases of placenta accreta, and were absent in most normal placenta.

Moreover, our data suggest that the lack of loss/irregularity of clear space may help exclude the diagnosis of placenta accreta. If the echolucent area between the placenta and the uterus is preserved, especially in cases of low anterior placenta, placenta accreta is unlikely to occur. We, therefore, confirm the findings of Comstock and Finberg and Williams

that the clear space should not be used as a single diagnostic criterion, but should be combined with other criteria with greater PPV (Comstock, 2011).

We looked for intraplacental lacunae using CDUS. Our investigative hypothesis was to determine a relationship between intralacunar turbulent flow and grade of placenta accreta. All cases with placenta percreta had more than six lacunae with turbulent flow inside. In our series, placenta lacunae had a relatively high PPV and low NPV of 100 and 57.14%, respectively, whereas a strong relationship between multiple placental lacunae with irregular shape and placenta accreta has been suspected by other authors (Finberg and Williams, 2011).

In this study, we relied upon spin echo sequences in assessing placental invasion to the myometrium or beyond as follows:

- T2-weighted images helped in distinguishing the intermediate signal intensity placental bulk from the inner and outer myometrial dark layers as well as from the myometrium itself, which is of more intermediate signal intensity
- T1-weighted images showed distended tortuous placental/myometrial vessels as clustered bright signal intensities (probably due to blood stagnation, especially in the pelvic and lower limb vessels accompanying pregnancy). The interface between the urinary bladder and the myometrium was also more clarified at that sequence. T2-weighted images may display overestimation of percreta. In such cases, we had to check for disruption of the fat plane

overlying the uterine serosa in T1-weighted sequence.

CONCLUSION

Ultrasound imaging is the mainstay of screening for placenta accreta. MRI appears to be complementary to CDUS, especially when there are few ultrasound signs or if there is a suspicion for invasion into surrounding organs. Sensitivity in the diagnosis of placenta accreta was 100% with CDUS and 76% for MRI. Specificity was 72% with ultrasonography and 52% for MRI respectively. Obliteration of the retroplacental clear space was found to have the highest sensitivity (63.6%) as a sign of CDUS. Focal interruption in the myometrial wall was found to have the highest sensitivity (73.7%) as a sign of MRI.

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دور الأشعة التليفزيونية والدوبلر الملون وأشعة الرنين المغناطيسي في تشخيص المشيمة الملتصقة

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خلفية البحث: يمكن أن تحدث المشيمة الملتصقة وفيات الأمهات بسبب نزيف حاد وأحياناً ما يهدد الحياة، والذي يتطلب غالباً نقل الدم وإستئصال الرحم. على الرغم من أهمية تقييم الفحص بالدوبلر الملون و الموجات فوق الصوتية، فإن عدم وجود نتائج الموجات فوق الصوتية لا يحول دون تشخيص طيف المشيمة الملتصقة؛ وبالتالي، لا تزال عوامل الخطر السريرية مهمة بنفس القدر مثل التنبؤات التي نحصل عليها من خلال نتائج الفحص بالدوبلر الملون والموجات فوق الصوتية. يُعد التشخيص السابق للولادة مرغوباً للغاية لأنه يتم تحسين النتائج عند حدوث الولادة في مرفق رعاية الأمومة من المستوى الثالث أو الرابع قبل بدء المخاض وتجنب اضطراب المشيمة. تعد الموجات فوق الصوتية و الدوبلر الملون أداة موثوقة لتشخيص المشيمة الغازية، وهي الأداة الرئيسية للتشخيص قبل الولادة للمشيمة الملتصقة. التصوير بالرنين المغناطيسي، على الرغم من توظيفه على نطاق واسع، لم يثبت بوضوح تحسن كبير في نتائج الحمل.

هدف البحث: تقييم دور الأشعة التليفزيونية والدوبلر الملون وأشعة الرنين المغناطيسي في تشخيص المشيمة الملتصقة.

المريضات وطرق البحث: تم إجراء دراسة حالة شواهد في مستشفيات جامعة الأزهر في الفترة ما بين نوفمبر 2017 ونوفمبر 2020. 50 سيدة في الثلث الثالث من الحمل مع تشخيص المشيمة الغازية المنزاحة وعملية قيصرية واحدة على الأقل. المجموعة الاولى، مجموعة المراقبة مكونة من 25 سيدة تم تشخيصهم على أنهم يعانون طيف المشيمة الملتصقة عن طريق تخطيط الدوبلر الملون. المجموعة الثانية: مجموعة الدراسة المكونة من 25 سيدة تم تشخيصهم على أنهم طيف المشيمة الملتصقة عن طريق الموجات فوق الصوتية دوبر الملونة

وخضعوا للتصوير بالرنين المغناطيسي. مع معايير التضمين والاستبعاد، تم إخضاع جميع النساء المشمولات؛ لأخذ التاريخ، والفحص البدني، وأضيفت الموجات فوق الصوتية التوليدية الملونة وفحص التصوير بالرنين المغناطيسي للمجموعة الثانية فقط لالتقاط السمات التي توجي بطيف المشيمة الملتصقة.

نتيجة البحث: في دراستنا كانت حساسية الموجات فوق الصوتية والدوبلر اللون 100% والخصوصية 72%. في حين كانت حساسية التصوير بالرنين المغناطيسي 76% والخصوصية 52%, وذلك في قدرتهم علي تشخيص المشيمة الملتصقة. وكان طمس الفضاء الصافي خلف المشيمة ذو أعلى حساسية (63.6%) كعلامة للموجات فوق الصوتية والدوبلر اللون. في حين وجد أن المقاطعة البؤرية في جدار الرحم لديها أعلى حساسية (73.7%) كعلامة للتصوير بالرنين المغناطيسي علي تشخيص المشيمة الملتصقة.

الاستنتاج: الموجات فوق الصوتية والدوبلر الملون لا تزال طريقة التصوير الأكثر حساسية لتشخيص مرض المشيمة الملتصقة ونقترح أن يكون التصوير بالرنين المغناطيسي هو مكمل للموجات فوق الصوتية، وخاصة في الحالات التي يكون فيها عدد قليل من علامات الموجات فوق الصوتية أو إذا كان هناك اشتباه في وجود غزو في الأنسجة المجاورة للرحم.

الكلمات الدالة: المشيمة الملتصقة، الموجات فوق الصوتية والدوبلر الملون، التصوير بالرنين المغناطيسي.