



COMPARISON OF ACCURACY OF ULTRASONOGRAPHY AND MAGNETIC RESONANCE IMAGING IN PRENATAL DIAGNOSIS OF PLACENTA ACCRETA

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ABSTRACT **Background:** Placenta accrete (PA) is a significant cause of maternal morbidity and mortality and is now the most common reason for emergent postpartum hysterectomy. Placenta accreta is a clinical and diagnostic challenge with increasing prevalence due to increasing number of pregnant patients undergoing primary and repeat cesarean sections. Accurate prenatal identification of affected pregnancies allows optimal obstetric management. USG and MRI are the only diagnostic modalities available for prenatal diagnosis of PA. Limited studies with a prospective paired study design have evaluated and compared the difference in diagnostic capabilities of MRI and USG in diagnosing Placenta accrete.

Objective: The study was undertaken to compare the diagnostic accuracy of trans-abdominal ultrasonography and magnetic resonance imaging for prenatal diagnosis of placenta accrete

Methods: The prospective paired study was conducted in the Department of Obstetrics and Gynaecology in collaboration with department of Radio diagnosis Sher-i-Kashmir Institute of Medical Sciences, Soura Srinagar over a period of two years i.e. August 2016 to August 2018. Antenatal women with high risk of placenta accrete; placenta previa in index pregnancy or history of previous LSCS, myomectomy or D&C were evaluated with USG at 28-30wks followed by MRI. Sonographic and MRI findings were compared with final diagnosis as determined at surgery and by pathological examination.

Results: A total of fifty patients with high risk for placenta accrete were evaluated with ultrasonography and MRI. Of these 50 patients, 25 patients had confirmation of placenta accrete at delivery. Sonography correctly identified the presence of placenta accrete in 23 of 25 patients (92% sensitivity, PPV 88.5%) and absence of placenta accrete in 22 of 25 patients (88% specificity, NPV 91.6%). MRI correctly identified the presence of placenta accrete in 21 of 25 patients (84% sensitivity, PPV 77.7%) and absence of placenta accrete in 19 of 25 (specificity 76%, NPV 82.6%). The difference in sensitivity (p value 0.38) and specificity (p value 0.26) between sonography and MRI was not statistically significant.

Conclusion: Both MRI and USG are reasonably accurate in diagnosing PA and no investigation is superior over other. For high risk patients initial screening should be done by ultrasound followed by MRI if inconclusive or negative results are obtained on USG

KEYWORDS : placenta accreta, magnetic resonance imaging, ultrasonography, cesarean, scar, placenta previa

INTRODUCTION:

Placenta accreta (PA) is the abnormal implantation of placenta into the uterine wall, occurs when a defect of the decidua basalis allows the invasion of chorionic villi into the myometrium. PA is classified on the basis of the depth of myometrial invasion. In placenta accreta vera, the mildest form of PA, villi are attached to the myometrium but do not invade the muscle. In placenta increta, villi partially invade the myometrium. The most severe form is placenta percreta, in which villi penetrate through the entire myometrial thickness or beyond the serosa (1). The clinical consequence of PA is massive hemorrhage at the time of placental separation. Blood loss averages 3-5 L and can lead to disseminated intravascular coagulopathy, adult respiratory distress syndrome, renal failure, and even death.

Hysterectomy is often required, leading to serious co-morbidities such as cystotomy (15.4% of cases), ureteral injury (2.1%), and pulmonary embolus (2.1%), with 26.6% of patients admitted to the intensive care unit (2-5). Placenta percreta can also lead to the destruction of adjacent organs, most often the bladder, or surgical injury of pelvic structures due to loss of tissue planes.

The prevalence of PA is difficult to determine accurately. The standard of reference is confirmation of the diagnosis with histologic findings; however, bleeding can sometimes be controlled without hysterectomy. In such cases, pathologic analysis is not available, and the clinical findings of (a) difficulty in manually removing the placenta or the need for surgical removal or, (b) uncontrolled bleeding after placental separation in a well-contracted uterus are generally used to determine the presence of PA. Unfortunately, pathologic diagnosis will lead to underestimation of the true prevalence of PA, and the use of clinical criteria will likely lead to overestimation. Two recent large studies conducted in the United States suggest a prevalence of one in 2500 deliveries, with both studies using clinical as well as pathologic diagnoses (2,6). Several studies suggest a higher prevalence of about one in 500 deliveries (7,8). The reason for this difference in prevalence is unclear. However, all studies suggest that the prevalence of PA has been increasing, and that PA has become the most common reason for emergent postpartum hysterectomy (7).

Prior cesarean section and placenta previa are the two most important risk factors for PA (2-8). Deficiency of the decidua basalis at the site of the scar is thought to be the causative factor. The cesarean section rate in the United States is now near 30%, and repeat cesarean deliveries in particular have increased. As these rates have increased, there has been a concomitant increase in PA. Previous cesarean section increases the odds of having PA by about 8.7 (7). Placenta previa with previous cesarean sections compounds the risk. In women with known placenta previa, 3% of those with no previous cesarean section had PA, compared with 11% of those with one previous cesarean section. As the number of cesarean sections increases, so does the risk. Among women with placenta previa, 40% of those with two previous cesarean sections and 61% of those with three previous cesarean sections have PA. These statistics illustrate the importance of the number of cesarean sections as a risk factor for PA (2-8). Advanced maternal age, uterine anomalies, previous uterine surgery, dilation and curettage, and myomectomy are additional but relatively minor risk factors (7). Maternal age greater than 35 years increases the odds of having PA by 3.2. However, this risk factor is most likely due to multiparity. Women with PA often have abnormally high second-trimester serum markers with elevated levels of α -fetoprotein and human chorionic gonadotropin (8). Abnormal placentation in any form often raises the level of these biologic markers.

Accurate prenatal identification of affected pregnancies allows optimal management because timing and site of delivery, availability of blood products, and recruitment of a skilled anesthesia and surgical team can be arranged in advance (3). Cesarean section is usually planned at 36 weeks gestation to minimize the risk of spontaneous labor. Surgical planning concerning matters such as site of incision and need for uterine artery balloon occlusion can be individualized. Detailed maternal counseling, including that concerning the desire for future fertility, can be taken into consideration during delivery planning. At some centers, conservative management with the placenta left in situ to spontaneously involute has been successful (9). This may be the treatment of choice if the patient desires future fertility. The prenatal diagnosis of PA also permits the family to be better prepared for a potential life-threatening obstetric complication.

In this study we determine the sensitivity, specificity, PPV and NPV of MRI and USG in diagnosing placenta accrete and compare the difference between the two modalities.

MATERIAL AND METHODS:

Antenatal women with placenta previa in index pregnancy and/or history of previous LSCS or uterine surgery were evaluated with USG at 28-30 weeks followed by MRI. A total of fifty women were identified and all underwent USG followed by MRI.

Imaging

USG and MRI were performed by two radiologists, each having 6 years of specific experience in interpreting ante-natal USG and MRI. The observers were blinded for the results. Sonographic findings were considered positive for accreta if the report concluded a high probability of placenta accreta. Findings that were considered suggestive of placenta accreta included loss of the retro-placental hypoechoic clear zone (fig 4-6), loss of the bladder wall-uterine interface, presence of placental lacunae (vascular spaces), and presence of hyper-vascularity at the interface between the uterine serosa and the bladder wall on color Doppler imaging (10,11). Magnetic resonance imaging findings were considered positive for placenta accreta if the report concluded a high probability of placenta accreta. Findings considered suggestive of placenta accreta included focal thinning or absence of the myometrium at the site of placental implantation, a nodular interface between the placenta and the uterus, a mass effect of the placenta on the uterus causing an outer bulge, heterogeneous signal intensity within the placenta, dark intraplacental bands on T2-weighted images (fig 1-3), and loss of the tissue plane between the placenta and bladder wall (3, 13, 14). For both sonography and MRI, if the report concluded low or no probability of placenta accreta, the findings were considered negative.

The sonographic examinations were performed on GE Logiq P5 ultrasound equipment. The examinations were performed with 3-5 MHz curvilinear probe in supine position after adequate distention of urinary bladder. No trans-vaginal examination was performed. Both grey scale and Doppler images were evaluated. MRI was performed with a 1.5-T scanner (Magnetom Vision, Siemens Medical Systems, Erlangen, Germany). T2-weighted half-Fourier RARE sequence (HASTE or half-Fourier single-shot fast spin-echo) were acquired in the axial, sagittal, and coronal plane. Balanced steady-state free precession (True FISP) sequence in three orthogonal planes and T1-weighted gradient-echo sequence in any one plane were also acquired. All these sequences were acquired during maternal breath holding. If placental accretion was suspected on the basis of preliminary survey, additional images in planes perpendicular to the placenta-myometrium or myometrium-bladder interface. The examinations were performed with adequate bladder distention. Examinations were performed in supine position and patients were routinely given oxygen via a nasal cannula to reduce fetal motions. Intravenous gadolinium was not used in any of the MRI studies.

Statistics:

The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated for both sonography and MRI. The sensitivity and specificity values of sonography and MRI were compared by chi-square test. Kappa test was used to calculate the agreement between USG and MRI. Mc Nemar test was used to calculate the discordance between MRI and USG.

Results:

A total of 50 patients who were clinically at high risk for placenta accreta were identified and underwent both sonography and MRI examination. Eighty-four percent of the patients had placenta previa; 96% had prior uterine surgery; and 80% had both. Table 1 shows baseline characteristics of the patients included in the study. Twenty five of these 50 patients had a diagnosis of placenta accreta clinically at delivery, by pathologic examination, or both.

Table 2 shows the sensitivity, specificity, PPV, and NPV of sonography and MRI for their ability to predict placenta accreta within this high-risk cohort. Sonography had sensitivity of 92% (95% confidence interval CI) and specificity of 88% (95% CI). Magnetic resonance imaging had sensitivity of 84% (95% CI) and specificity of 76% (95% CI). We found no significant difference in the sensitivity and specificity of sonography and MRI (sensitivity: sonography, 92%, versus MRI, 84%; $P=0.38$; specificity: sonography, 88%, versus MRI, 76%; $P=0.26$).

In our study out of 15 posterior wall placenta 6 had placenta accrete.

MRI correctly identified accrete in 5 of 6 cases while USG identified accreta in 2 of 6 cases. Sensitivity of MRI in detecting posterior wall placenta accrete was 83.3% and sensitivity of USG in detecting PA was 50%. Sonography and MRI were discordant in their diagnosis in 13 cases (fig 7). In these, sonography was correct in 8 cases, and MRI was correct in 5 cases. This was not statistically significant. K value was 0.343. The strength of agreement was considered to be fair.

DISCUSSION:

In this prospective paired study a total of 50 patients with high risk for placenta accreta were identified. Out of 50 patients, 42 patients had placenta previa, 48 patients had prior uterine surgery including LSCS and 40 patients had both placenta previa and prior uterine surgery. Posterior wall placenta was seen in 15 cases. Out of 15 cases 6 had placenta accrete.

The study established that sonography and non-contrast MRI appear to have similar accuracy for correctly diagnosing placenta accrete. In our study sensitivity of USG with Doppler and MRI without contrast was 92% & 84% respectively. The specificity was 88% & 76% respectively. In literature a wide range of sensitivity and specificity has been published. The sensitivity of USG ranges from 33 to 100% and specificity from 50 to 90% (15-27) and sensitivity of MRI range from 38 to 100% and its specificity from 55 to 100% (16-22, 24, 25, 27-28). In our study difference in sensitivity and specificity between USG and MRI was not statistically significant. The results were in accordance to three recently published meta-analysis considering accuracy of USG for diagnosing of placenta accreta (22), the use of MRI (23) and a comparison of USG and MRI (27).

D'Antonio et al (22, 23) reported a sensitivity of 90.7% for USG and 94.4% for MRI and specificity of 96.9% for USG and 84% for MRI. Meng et al (27) showed that USG sensitivity was 83% and its specificity was 95% compared with 82% and 88% respectively for MRI. Warshak et al (29) reported on 39 cases of confirmed placenta accrete with an unpaired study design. USG had sensitivity of 96%. MRI with gadolinium had sensitivity of 88% and specificity of 100%.

Several authors found a better performance of MRI compared to USG to diagnose placenta accreta when placenta have a posterior insertion (21, 30-32). In our study out of 15 posterior wall placenta 6 had placenta accrete. MRI correctly identified accrete in five of six cases while USG identified accreta in 2 of 6 cases. Sensitivity of MRI in detecting posterior wall placenta accrete was 83.3% and sensitivity of USG in detecting PA was 50%. The difference was statistical insignificant with p value of 0.07.

The meta-analysis included studies that were clinically and methodologically varied and in which USG and MRI were not applied to the same population. This methodology was not without bias. Also in warshak study MRI examination was done only in case with positive USG suspicious findings.

The strength of our study was that it directly compared the accuracy of sonography and MRI in the same group of patients. All 50 patients underwent both MRI and USG exam irrespective of USG findings. The only limitation of our study was a small sample size of 50 instead of 194 to have 80% power to detect a difference at 0.05 level.

Table 1: Baseline characteristics of the patients included in the study

	N=50
AVERAGE AGE IN YEARS	31.54
GRAVIDITY	3.02
PARITY	2.2
PREVIOUS CESAREAN DELIVERY	42
PREVIOUS MYOMECTOMY	6
PREVIOUS D&C	25
PLACENTAL INSERTION	
PREVIA	42
ANTERIOR	32
POSTERIOR	10
NORMAL	8
ANTERIOR	3
POSTERIOR	5
PLACENTA ACCRETA/INCRETA/PERCRETA	25
NON ADHERENT PLACENTA	25

SURGICAL MANAGEMENT AT DELIVERY	
VAGINAL DELIVERY	4
CONSERVATIVE	2
HYSTERECTOMY	2
CESAREAN DELIVERY	46
COMPLETE DELIVERY	14
INCOMPLETE DELIVERY	5
CONSERVATIVE MANAGEMENT	15
CESAREAN HYSTERECTOMY	12

Table 2: sensitivity, specificity, PPV, and NPV of sonography and MRI predicting placenta accreta

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
USG	92	88	88.5	91.6	90
MRI	84	76	77.7	82.6	80
P-VALUE	0.38	0.26			

Fig7: showing concordance between USG and MRI

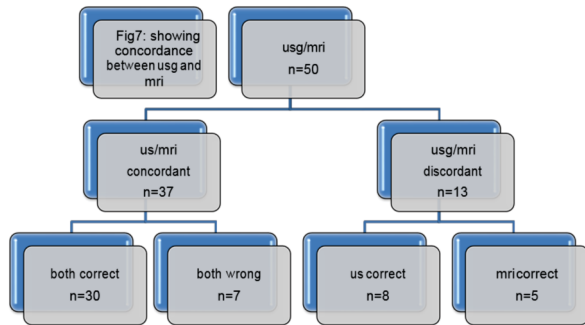


Fig 1: sagittal T2 HASTE image showing placenta previa (white star), lower uterine bulge and myometrial thinning.

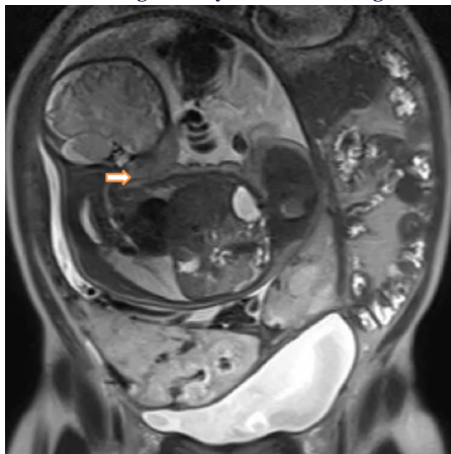


Fig2: coronal T2 HASTE image showing low-signal-intensity placental bands(white arrow) extending from myometrial-placental interface and intra-placental hemorrhage

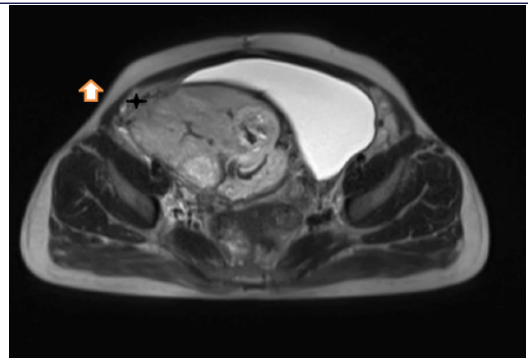


Fig3:axial T2-weighted HASTE image shows higher signal intensity placenta extending through the serosal surface(white arrow) along right lateral uterine wall and intra placental lacunae and bands(star)

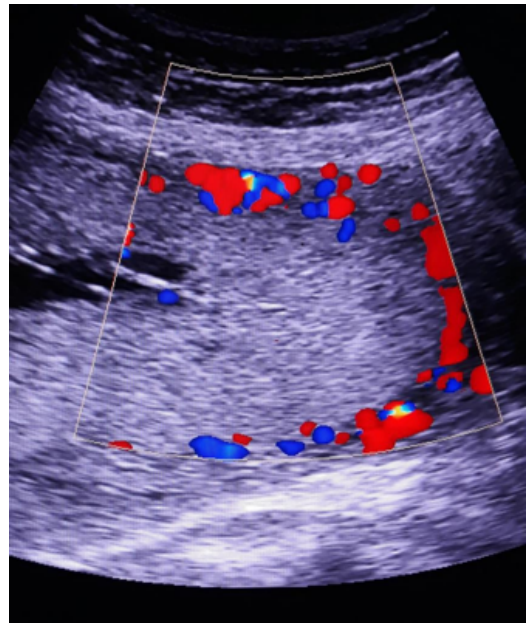


Fig4: sagittal trans abdominal US image shows a normal organized pattern of sub placental blood flow that parallels the myometrium.

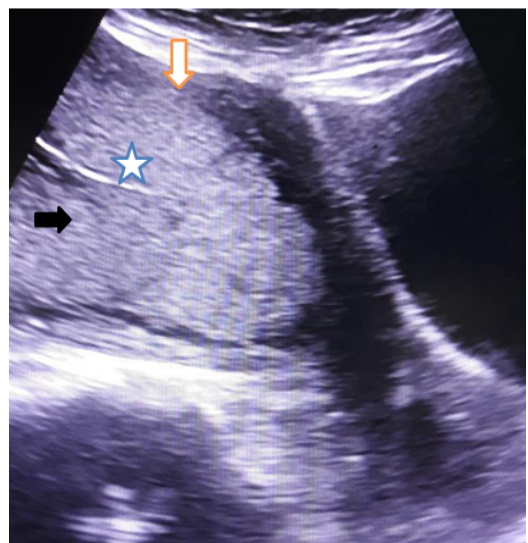


Fig5: sagittal transabdominal US image shows the hyperechoic placenta(white star) surrounded by the hypoechoic myometrium(white arrow), a thin hypoechoic line is shown at the inner aspect of myometrium representing a subplacental clear space(black arrow)

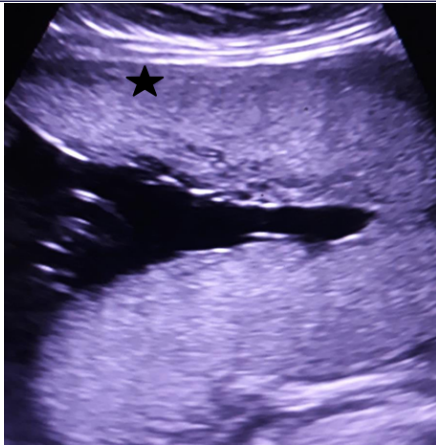


Fig6: sagittal trans abdominal US image showing loss of retro placental clear space along anterior aspect (black star).

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