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COMPARATIVE DIAGNOSTIC ACCURACY OF ULTRASOUND AND MAGNETIC RESONANCE IMAGINGFOR PLACENTA ACCRETA IN PREVIOUS SCAR PATIENTS TAKING CLINICAL OUTCOME AS GOLD STANDARD

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ABSTRACT

Objective: To compare the diagnostic accuracy of magnetic resonance imaging (MRI) and ultrasound (USG) in clinically suspected cases of placenta accreta in previous scar patients taking clinical outcome as Gold standard.

Study Design: Cross-sectional validation study.

Duration and Place of Study: Combined Military Hospital, Quetta Pakistan, from Oct 2016 to Mar 2017.

Methodology: This study enrolled pregnant ladies having history of previous one or more caesarean sections, age ranging from 20-40 years and gestational age 37-41 weeks. The ultrasound & magnetic resonance imaging findings were recorded as positive or negative for placenta accreta and then correlated with clinical outcome.

Results: The data of 155 patients were analysed. Out of 155, 86 patients were found to be positive on magnetic resonance imaging. Among them, 78 were found to be true positive and 8 were false positive. While among, 69 patients with negative findings on magnetic resonance imaging, 12 were false negative whereas 57 were true negative. Overall diagnostic accuracy, specificity, sensitivity, positive predictive value and negative predictive value of magnetic resonance imaging for placenta accreta was 87.09%, 82.60%, 90.69%, 86.67% & 82.69% respectively. In 82 patients with positive findings on ultrasound, 71 were true positive and 11 were found to be False Positive. While among, 73 ultrasound negative patients, 14 were false negative whereas 59 were true negative. Overall diagnostic accuracy, sensitivity, specificity, positive and negative predictive value of ultrasound for placenta accreta was 83.87%, 86.5%, 80.82%, 83.53% and 84.28% respectively.

Conclusion: Magnetic resonance imaging andultrasonography are highly sensitive and accurate imaging modalities for diagnosing placenta accreta in previous scar patients and have comparable diagnostic accuracies.

Keywords: Magnetic resonance imaging, placenta accreta, ultrasound, sensitivity.

INTRODUCTION

Everywhere in the world especially in third world countries maternal mortality is a major concern. Several measures have been taken to reduce its incidence, mainly by focusing at its risk factors. Placenta accreta is emerging as an increasingly common complication in pregnant ladies in this modern era. Maternal morbidity has been documented in about 60% and mortality in 7% of women with this pathology[1]. Moreover, the incidence of fetal morbidity in terms of preterm birth along with small for gestational age foetuses is also increased in affected women.

Major risk factors for placenta accreta include previous caesarean sections and placenta previa. Its prevalence is about 24% in women with placenta previa and one previous scar[2]. While the prevalence is raised to about 67%, in women with placenta previa and three or more previous scars[2]. Maternal age over 35 years, multiparty and history of any previous uterine surgery are additional risk factors for it.Its dreadful complications include: life threatening bleeding, sepsis, disseminated intravascular coagulation etc which can and or peripartum hysterectomy. Even death has been reported in previously undiagnosed or poorly managed cases.

One of the major cause of raised incidence of abnormal placentation in developed countries is increased in caesarean delivery rate. Recent studies estimated that its incidence is from 1 in 2500 to as many as 1 in 500 pregnancies now a days[3]. Abnormal placentation usually hampers natural process of spontaneous separation of placenta from myometrial bed in third stage of labour resulting in severe-postpartum haemorrhage or retained products of conception and its complications. So the importance of prenatal diagnosis of placenta accreta lies in the fact that it allows timely intervention to prevent significant pre and post partum blood loss[4].

The first line modality for prenatal diagnosis is ultrasound (grey scale and colourdoppler). It is readily available, cost effective and free of radiation hazard to both mother and foetus. Its reported sensitivity in one of our national studies is about 86% and specificity is

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71% with positive predictive value of 85%[5]. However, its limitations are due to the resolution capability of the ultrasound machine used and operator based variations in interpretation of results.

Magnetic resonance imaging has now emerged as a second line investigation for morbidly adherent placenta. It is used either as a complementary investigation for confirmation of diagnosis or reserved for further characterization when USG findings are equivocal[6]. Its sensitivity is reported to be about 84% and specificity is 80%[7]. It is relatively safe and free of risk of ionizing radiations to mother and foetus. However, it is expensive and has limited availability now a days.

According to NICE guidelines, all pregnant women suspected or diagnosed to have abnormal placentation are offered an elective caesarean section at or around 35 weeks of gestation[8]. An emergency caesarean section can be done at any gestational age during pregnancy if any complication arises. Per operative findings are usually confirmatory for presence or absence of placenta accreta. However, histopathology can also be done in equivocal cases.

The rationale of conducting this study was to collect local data to determine the diagnostic accuracies of MRI and USG in detecting placenta accreta in previous scar patients. This would help to increase the accuracy of prenatal diagnosis of this condition and in reducing both maternal and fetal mortality and morbidity.

METHODOLOGY

This cross-sectional validation study was conducted after approval from the ethics committee of hospital at the radiology department of Combined Military Hospital (CMH), Quetta, Pakistan, from 1 October 2016 to March 2017. The data was collected after getting informed written consent from all patients. A total of 155 pregnant ladies were included in the study. Sample size was calculated using WHO sample size calculator with margin of error 5%, confidence interval 95%, sensitivity 84%, specificity=80% and prevalence=24%. Non-probability, consecutive sampling was done. Patients fulfilling the inclusion criteria i.e. having history of previous one or more caesarean sections, age ranging from 20-40 years & gestational age of 37-41 weeks were included in the study. While patients having previous history of normal spontaneous vertex deliveries, primigravida, history of claustrophobia and general contraindication to MRI were excluded. All the patients underwent grey scale and colour doppler USG and MRI.

Ultrasound wasdone on Toshiba Nemio XG (SSA-580A) Doppler ultrasound machine using 3.5 MHZ curvilinear transducer. After doing ultrasound, MRI was done on 1.5 T scanner (Siemens medical system). Basic MRI protocol include T2-weighted Half Fourier RARE sequence in axial, sagittal and coronal planes. Additionally balanced steady state free precession (FISP) sequence in three orthogonal planes and T1-weighted gradient echo sequence were taken in planes perpendicular to myometrial-placental or myometrial bladder interface[7]. These fast sequences cause significant reduction in image acquisition time durationand reduction in motion artefacts due to the foetus. No contrast agent was used. Images were analysed by experienced radiologist.

The USG & MRI findings were recorded as positive or negative for placenta accreta. Patients diagnosed to have placenta accretawere offered an elective caesarean section at 37-38 weeks or an emergency section done if at any age of gestation vaginal bleeding started. Peroperative findings of low lying placenta adherent to myometrium or urinary bladder were taken as positive for morbidly adherent placenta.

Information regarding different characteristics including age, parity, gestational age, history of previous caesarean sections and other risk factors were taken on a pre-designed proforma. Results regarding ultrasound and MRI findings along with peropertaive findings were also recorded on the Proforma.

Data was entered and analyzed using Statistical Package for the Social Science (SPSS) version 10. Frequencies and percentages were calculated for qualitative variables like positive and negative results on the basis of ultrasound and MRI findings. For quantitative variables like age, parity, gestational age, number of previous scars, mean SD was calculated.

Sensitivity, specificity, positive predictive value and negative predictive value and diagnostic accuracy for ultrasound and magnetic resonance imaging were calculated using 2x2 table and specific formulas.

RESULTS

Patients included in this study were in age group from 20-40 years. While majority patients i.e. 82 (52.90%) were in age range of 20-30 years. One hundred and one patients (65.16%) out of total 155 patients, were between 37-39 weeks of gestation with mean gestational age of 38.23 ± 1.49 weeks. The mean parity was 3.41 ± 1.68. Mean previous scar was 2.52 ± 1.23.

All the patients were subjected to USG and MRI. MRI supported the finding of placenta accreta in 86 patients. After MRI, patientswere followed till surgery. Clinical outcome confirmed placenta accreta in 90 cases where as 65 patients revealed no placenta accreta. In 86 patients with positive MRI findings, 78 had placenta accretai.e True positive and 8 had negative findings on clinical outcome i.e false positive. Among, 69 MRI negative patients, 12 (false negative) had placenta accreta whereas 57 (true negative) had negative findings on clinical outcome as shown in table-I. Calculated sensitivity, specificity, PPV, NPV and diagnostic accuracy of MRI in placenta accreta was 90.69%, 82.60%, 86.67% 87.69% and 87.09% respectively.

USG suggested findings of placenta accreta in 82 patients. Clinical outcome confirmed placenta accreta in 85 cases where as 70 patients revealed no placenta accreta. In 82 patients with positive USG findings, 71 (true positive) had placenta accreta and 11 (false positive) had negative findings on clinical outcome. Among, 73 USG negative patients, 14 (false negative) had placenta accreta on clinical outcome whereas 59 (true negative) were found to be normal on clinical outcome as shown in table-II. Overall sensitivity, specificity, PPV, NPV and diagnostic accuracy of USG in placenta accreta was 86.50%, 80.82%, 83.53% 84.28% and 83.87%

Table-I: Magnetic resonance imagingand clinical outcome.

	Positive Result on Clinical Outcome	Negative Result on Clinical Outcome	Total	*p*-value
Positive on MRI	78 (TP)*	08 (FP)***	86	<0.01
Negative on MRI	12 (FN)**	57 (TN)****	99	
Total	90	65		

**TP=True positive **FP=False positive ***FN=False negative ****TN=True negative. Sensitivity = 90.69%, Specificity = 82.60%, PPV = 86.67%, NPV= 87.69%, Diagnostic accuracy = 87.09%.*

Table-II: Ultrasound and clinical outcome.

	Positive Result on Clinical Outcome	Negative Result Clinical Outcome	Total	*p*-value
Positive on USG	71 (TP)*	11 (FP)***	82	<0.001
Negative on USG	14 (FN)**	59 (TN)****	73	
Total	85	70		

**TP=True positive **FP=False positive ***FN=False negative ****TN=True negative. Sensitivity=86.50%, Specificity=0.82%, PPV=83.53%, NPV=84.28%, Diagnostic accuracy=83.87%.*

respectively.

DISCUSSION

Accurate prenatal diagnosis of placenta accreta is crucial for ante and postnatal patient management. Based on this diagnosis, the patient is planned for delivery via caesarean section usually at a tertiary care setup. Clinicians should know about the clinical issues and risk factors intrinsically related to this disease, and radiologists with imaging protocols of USG & MRI and findings diagnostic for it to facilitate optimal case management. Ultrasonography and magnetic resonance imaging (MRI) both areusually dependent on the expertise of the sonographer or radiologist[9,10]. This study was basically conducted to determine the diagnostic accuracy of USG and MRI for placenta accreta in previous scar patients taking clinical outcome as gold standard and to highlight main imaging findings of this disease on both modalities.

Age range of patients in this study was from 20-40 years.Out of these 155 patients, 101 (65.16%) were between 37-39 weeks of gestation with mean gestational age of 38.23 ± 1.49 weeks. All the patients were subjected to USG and MRI. This study concluded diagnostic accuracyof 83.87% of USG for placenta accreta and 87.09% of MRI for placenta accreta.

A cohort study undertaken at three institutions identified 15 cases of confirmed placenta accreta in a high-risk group of 32 patients who underwent both MRI and Doppler ultrasound evaluation antenatally. The sensitivity of both modalities was fairly good, whereas the specificity was low as compared to other similar studies[11]. One of the studies comparing USG and MRI with gadolinium for prenatal diagnosis of placenta accreta was conducted by Warshak *et al*[12]. Another prospective study by Masselli *et al*[13], identified 12 cases of placenta accreta in a group of 50 high-risk patients. They reported a sensitivity of 100% and 91% for MRI and colour doppler USG, respectively, and a specificity of 100% for both modalities. They concluded that MRI was statistically better than USG in evaluation of depth of placental infiltration and more accurate in characterizing the topography of invasion.

In another observational study, 577 women had a diagnosis of varying grades of low lying placenta[14]. Of these, in 42 cases placenta accreta was confirmed after delivery by histopathology, and 39 cases were diagnosed prenatally. Ultrasound findings accurately predicted the diagnosis of placenta accreta in 33 out of 39 women and ruled out placenta accreta in 512 patients (95.1% sensitivity and 95.5% specificity). In 20 women

MRI was done because of the suspicion of placenta accreta by ultrasonography. MRI diagnosed placenta accreta in 6 out of 20 cases and ruled out placenta accreta in 10 out of 20 cases (85.7% sensitivity and 76.9% specificity)[14]. The results in this study were comparable to our study.

Figure-1: Doppler ultrasonography shows vessels crossing from placenta to myometrium (Placenta accreta).

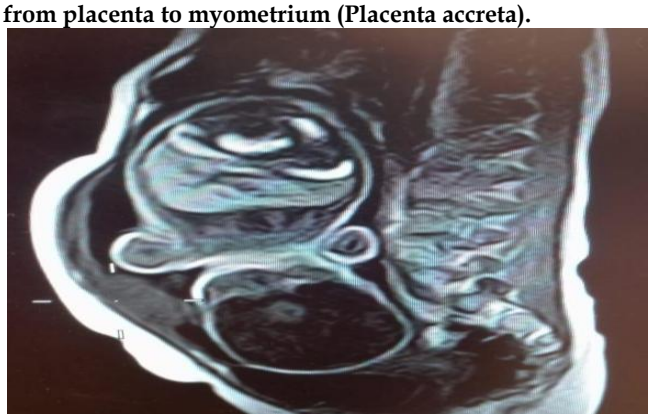

Figure-2: T2WS sagittal image shows indistinct placental-myometrial interface at the site previous C-section scar.

The ultrasonographic features of greatest sensitivity forplacenta accreta are intraplacental lacunae and loss of the normal 1mm retroplacental clear space. Increased vascularity in the uterine serosa-bladder wall interface along with perpendicularly oriented vessels extending along the uterine serosa-bladder wall interfaceas shown in fig-1 had the highest positive predictive value of 92%. At MRI, focal uterine bulging alone had the positive predictive value of 85%. This in combination with the presence of dark intraplacental bands on T2-weighted sequences raised predictive value to 90%[15]. In distinct placental-myometrial interface at the site of previous scar as shown in fig-2 was also a common finding especially in previous scar patients.

In a study conducted by Elhawary *et al*[15], placenta accreta was diagnosed in 8/39 (20.5%) patients on surgery. Sensitivity, specificity, PPV and NPV of US and MRI were 82%, 89.6%, 72.7%, 92.8% and 88.8%, 86.8%, 66.6%, 96.2% respectively.

Both colour doppler USG and MRI have all been used for diagnosing placenta accreta with varying specificity and sensitivity in different studies conducted so far. Colour doppler USG is the initial step for detection of placenta accreta. MRI is mostly used as a complementary tool when ultrasound findings are equivocal or when the placenta is visualized with difficulty on ultrasound examination as in cases of posteriorly located low lying placentas[16].

CONCLUSION

This study concluded that both MRI and USG for detecting placenta accreta in previous scar patients are highly sensitive and accurate imaging modalities.There is no statistically significant difference in their sensitivity and specificity and they have comparable diagnostic accuracies. USG can be preferably used as first line screening test due to its readily availability and being a patient friendly technique. However MRI is problem solving in cases of posteriorly placed low lying placentas and in cases where ultrasound findings are equivocal. So, recommendation is that USG and MRI both, should be routinely used in compliment with each other, where ever available for accurate diagnosis of placenta accreta in previous scar patients to reduce maternal morbidity and mortality.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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