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Original Research Article

Comparison of radiological imaging techniques for placenta accreta spectrum to optimise fetomaternal outcome by antenatal detection and management plan at a tertiary care centre

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ABSTRACT

Background: Placenta accreta spectrum remains one of the most dangerous obstetric conditions especially when antenatal suspicion amounts to nil, resulting in severe fetomaternal outcomes. Therefore, accurate and optimal prenatal imaging is mandatory to instigate necessary preparation and strategic management approach.

Methods: We conducted a prospective study in our tertiary care centre, Punjab in duration of 18 months enrolling 54 antenatal patients fulfilling the inclusion criteria, reporting to the labour room by non-probability convenient sampling technique. Patients were subjected to radiological imaging (both ultrasonography and MRI) which was then followed by surgery. The data was analysed using suitable statistical software.

Results: We observed that patients with previous history of some surgery, be it caesarean section or D and C, pose a greater threat of acquiring placenta accreta syndrome and may tend to cause preterm births. Thus, requisiting antenatal diagnosis with the intent to ameliorate fetomaternal outcomes.

Conclusions: MRI has better diagnostic accuracy in terms of sensitivity and overall accuracy than sonography. Although cost and accessibility may limit the use of MRI, both aid in prenatal assessment and multi-disciplinary approach to help improve maternal and fetal outcome.

Keywords: Fetomaternal outcome, MRI, Placenta accreta spectrum, Sonography

INTRODUCTION

Placenta accreta spectrum is defined as an entity where abnormal trophoblastic invasion into the myometrium layer of the uterine wall occurs either partially or completely, therefore formally known as morbidly adherent placenta.¹ The incidence of placenta accreta spectrum is 1.7 per 10,000 deliveries and is increasing significantly because of rising number of caesarean

deliveries, contributing to maternal morbidity and mortality.^{1,2}

Many theories have been speculated, among which the most approbated is the defect of endometrial interface leading to failure of normal decidualisation in the area of the uterine scar, which allows trophoblastic infiltration and placental villi to anchor deeply. So, placenta accreta spectrum is graded typically according to the extent of placental involvement as: a) Placenta accreta vera (villi

attached to myometrium) 79%, b) placenta increta (partial myometrium invasion) 14%, c) placenta percreta (penetrating entire myometrium, with adjacent organs involvement occasionally) 7%.^{1,3}

Previous caesarean section and placenta previa are the major risk factors while others being smoking, multiparity, advanced maternal age, Asherman syndrome, thermal ablation, prior pelvic radiation, previous trophoblastic disease, uterine anomalies, or any other prior uterine surgery.⁴

The extent of morbidity depends on the degree of extension and neo vascularisation in the surrounding structures. Since there is skimpy myometrium to act as living ligature, any attempt of removal or detachment per se can lead to torrential bleeding especially if unrecognised before delivery and is responsible for maximum emergency peripartum hysterectomies. Thus, antenatal diagnosis is highly desirable to optimise maternal and fetal outcome.⁵

Accurate prenatal diagnosis is usually onerous as literature on radiological choice can be contradictory and confusing. Beginning with the first imaging modality, Ultrasound done in first trimester aids in diagnosis of PAS with following findings on grey scale: gestational sac in lower segment, irregular vascular spaces in placental bed and implantation on previous scar. In later gestation, multiple irregular lacunae in placenta giving moth eaten appearance or Swiss cheese appearance, loss of hypo echoic retro placental space, myometrium thinning (<1 mm) and invasion to nearby organs can be seen with a sensitivity of 57% and false positive rate of 48%.⁶

The sensitivity increases to 92% with positive predictive value of 76% with addition of colour Doppler while when 3D power Doppler is added, sensitivity increases to 100% where in findings consistent with focal turbulent lacunar flow, vascular lakes, hyper vascularity at serosa and bladder interface, uterine placental margin or myometrium bladder interface, inseparable cotyledonal and Intervillous circulation and distorted vessels, point towards the diagnosis of PAS.^{7,8}

RCOG guidelines suggest 3D power Doppler to be superior to colour Doppler and grey scale ultrasound in antenatal diagnosis.⁹ However, in later gestation, MRI is now emerging as better diagnostic modality when carried out at 28 to 31 weeks of gestation. MR predictive signs of PAS include: intraplacental T2 dark bands, Myometrium thinning, Heterogenous placental signal intensity, Placental protrusion sign, uterine bulging, abnormal placental vascularity, placental recess, and percreta signs.^{10,11}

A standardised approach for prenatal diagnosis, incorporating clinical risk, and ultrasound findings, suggestive of placental invasion was developed known as placenta accreta index (PAI) which includes number of

previous caesarean deliveries, presence of lacunae and presence of bridging vessels. >8 score gives 96% probability of invasion with 100% specificity.¹²

Using the above various modalities, diagnosis of PAS can be made antenatally and thus help in preventing dreadful complications in terms of PPH, DIC, shock, bladder and ureteral complications, pulmonary embolism, renal failure, and peripartum hysterectomy.

Aims and objectives

To study the comparison between radio diagnostic accuracy and intraoperative findings in diagnosis of placenta accreta spectrum and evaluate its impact on fetomaternal outcome

METHODS

Study design

It was a prospective study conducted in tertiary care centre, Punjab.

Study duration

The study duration was 18 months (April 2021 - October 2022).

Study population

We enrolled 54 antenatal patients fulfilling all criteria, reporting to the labour room of the department of obstetrics and gynecology at Guru Gobind Singh Medical College and Hospital, Faridkot by non-probability convenient sampling technique.

Inclusion criteria

All pregnant females, more than 28weeks period of gestation with the diagnosis of placenta accreta spectrum on ultrasound or MRI

Exclusion criteria

Patients presenting in emergency in labour without any prior investigations or diagnosed intraoperatively without prior radiological evidence.

Data collection

Data was collected using self-structured proforma with written informed consent after approval from institutional ethical committee. Detailed history, thorough examination, relevant investigations including ultrasonography and MRI findings were noted. The patients were planned for surgery and intra-operative findings were recorded, to be then correlated with imaging findings.

Statistical analysis

The data was statistically analysed to compare the MRI and histopathology findings using paired t-test. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were calculated along with their 95% confidence intervals.

The data pertaining to socio-demographic and other clinical variables entered in the form of a data matrix in Microsoft® Excel® was analysed using IBM® SPSS® (Statistical Product and Service Solutions) version 20.0.0. (2013, Armonk, NY: IBM Corp) in the light of suitable statistical test as explained below:

Mean values

Mean values for individual group of 50 patients were determined by pooling the results of individual patients and dividing it by 50 (number of observations).

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$$

Σx = Sum of all observations.

n = number of subjects

Standard deviation (SD)

It is the square root of the average of the squared deviations of different values from their mean i.e. the “root mean-square” deviation.

Standard deviation was calculated as follows:

$$SD = \sqrt{\frac{\sum |x - \bar{x}|^2}{n}}$$

Steps

Calculate the mean ($\bar{x}$) of all the values x .

Find the difference of each value from the mean $d = x - \bar{x}$

Square each of the differences d^2 .

Add up the squares and divide the sum of Σd^2 by the number of observations (n).

If sample size is less than 30 then we divide by $n-1$, then take the square root of whole value.

Standard error of mean

It describes the variability of the mean of the experimental value as one of a number of mean values which might have been obtained from other similar experiment.

$$SEM = \frac{SD}{\sqrt{n}}$$

Sensitivity measures the proportion of positives that are correctly identified and can be calculated by the following formula (as from above table values):

$$a/a+c \times 100$$

Specificity measures the proportion of negatives that are correctly identified and can be calculated by the following formula (as from above table values):

$$d/d+b \times 100$$

The positive and negative predictive values (PPV and NPV respectively) are the proportions of positive and negative results in statistics and diagnostic tests that are true positive and true negative results, respectively.¹ The PPV and NPV describe the performance of a diagnostic test and can be calculated by the following formula:

$$PPV = a/a+b \times 100$$

$$NPV = d/d+c \times 100$$

$$\text{Accuracy} = (a+d) / (a+b+c+d)$$

The accuracy of radiological findings and its help in the production of invasive presentation was assessed by comparing them with intra-operative findings post-surgery. Retrospective correlation was established between the preoperative imaging findings and intra-operative findings. Plan of management undertaken and the intra and post-operative complications along with foeto-maternal outcome were noted.

RESULTS

In our study, the mean age of patients was 29.61 ± 31.2 years and majority (51.8%) of the patients were multiparous as is shown in Table 1.

Table 1: Demographic data.

Age (years)	No. of cases	Percentage
≤25	4	7.4
26-30	22	40.7
31-35	18	33.3
>35	10	18.5
Total	54	100
Parity		
Primiparous	26	48.14
Multiparous	28	51.8
Total	54	100

85.20% patients without PAS were primiparous while multiparous patients had presence of PAS in 70.3%

patients with a mean parity of 1.82 ± 0.7 as is depicted in Figure 1.

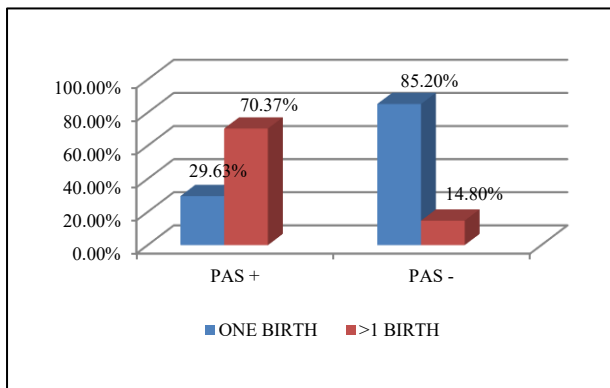


Figure 1: Association of parity to intra-operative diagnosis.

Table 2: Distribution of patients according to prior number of interventions and its association with PAS.

Number of caesarean sections	Number of cases	Percentage
Previous 1 LSCS	17	31.48
Previous 2 LSCS	25	46.29
Previous 3 LSCS	12	22.23
Number of Curettages		
Nil	17	31.48
1 D and C	18	33.33
2 D and C	12	22.23
>2 D and C	7	12.96
Total	54	100%
Number of caesarean sections	PAS present (%)	PAS not present (%)
Previous 1 LSCS	28.9	71.1
Previous 2 LSCS	50	50
Previous 3 LSCS	21.1	78.9
Total	100	100

In the present study, 12.96% patients had history of >2 previous curettages while 46.29% patients had previous 2 caesarean sections as depicted in Table 2.

Patients with PAS mostly had history of one or more D&C but this association was not significant (p value =0.19) whereas those who underwent more than 1 LSCS showed 71.1% patients with presence of PAS (p value =0.016) as shown in Table 2.

Figure 2 shows that in our study out of 54 patients, ultrasound findings ranged from myometrial thinning in majority (75.9%) of patients to retroplacental lakes seen in 48.14% cases. All the findings were statistically significant.

As depicted in Figure 3, MRI shows that myometrial thinning was seen in 64.40% cases among which 70.3%

patients were consistent with PAS found intra-operatively. Tenting of bladder was seen in 11 cases with 100% findings intra-operatively as was with loss of serosal planes seen intra-operatively. Similarly, uterine bulge was present in 48.15% cases on MRI with 84.6% consistency intra-operatively. Hyperintense lacunae seen in 87.03% patients on MRI could be confirmed only in 76.08% cases with PAS intra-operatively. All these findings were statistically significant with p value <0.001.

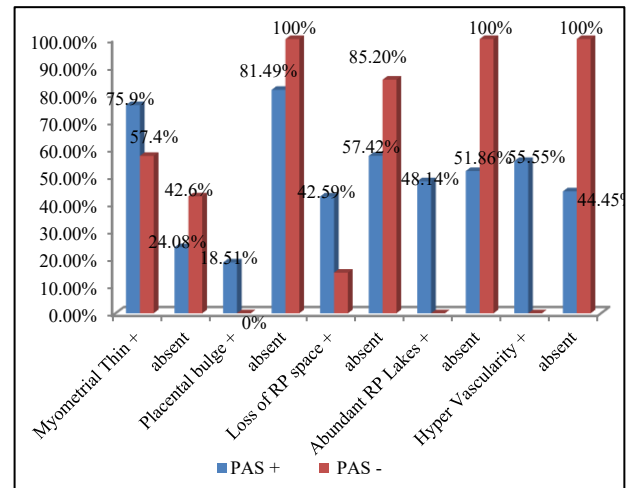


Figure 2: Comparison of ultrasonographic findings with intra-operative findings.

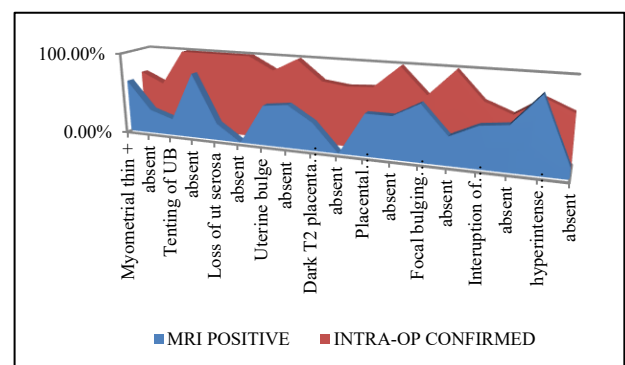


Figure 3: Comparison of MRI findings with intra-operative findings (PAS).

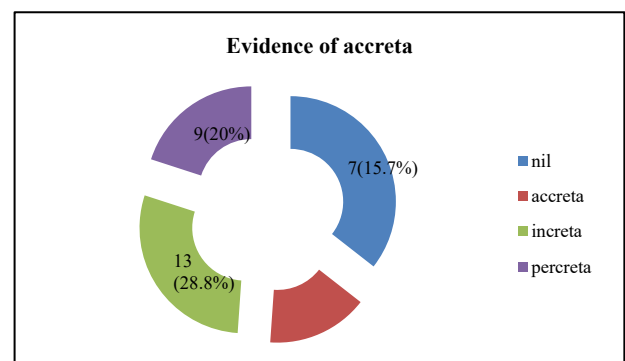


Figure 4: Distribution of patients according to diagnosis confirmed intra-operatively.

Out of 54 patients, 29.62% had no evidence of PAS while 12.96% showed accreta, 24.07% were diagnosed with increta and 16.67% showed percreta at the time of delivery as is depicted in Figure 4.

Table 3: Distribution of patients according to post-op complications.

Complications	Number	Percentage
PPH	21	38.9
Vesico-vaginal fistula	1	1.85
Wound related	5	9.25
Collateral syndromes	7	12.96
ICU admission	18	33.33
Maternal mortality	2	0.03

21 patients had PPH among whom 6 patients underwent shock. Among ICU admissions, 6 patients required inotropic support while 6 were intubated and 8 patients required ventilatory support. 5 patients developed ARDS with 2 suffering from MODS and 3 patients went into DIC as is depicted in Table 3.

Table 4: Distribution of neonates according to birth weight at the time of delivery.

Gestational age	Number of cases	Mean birth weight (kg)	SD	f-value	P value
≤30 weeks	3	1.533	0.25	9.8	<0.01
31-32weeks	14	1.914	0.24		
33-34weeks	18	1.989	0.12		
35-36weeks	19	2.170	0.15		
Total	54	1.976	0.23		

In our study, 35 patients delivered at ≤34 weeks with neonates weighing <2 kg at birth. The mean birth weight observed was 1.97 ± 0.23 kg with significant association as is shown in Table 4.

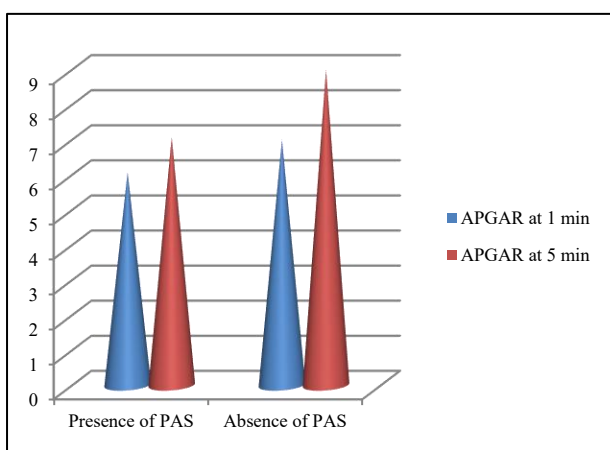


Figure 6: Distribution of neonates according to APGAR scores at 1 and 5 minutes.

APGAR score was significantly more in neonates without PAS at 1 and 5 minutes as is depicted in Figure 6.

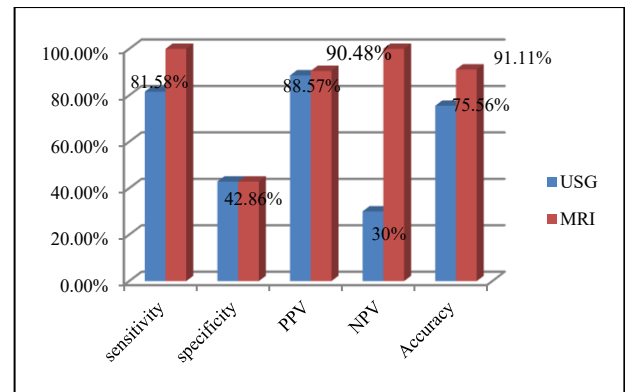


Figure 5: Comparison of sensitivity, specificity, PPV, NPV and accuracy of ultrasound and MRI in PAS.

In the present study, MRI correctly identified 44 (true positives) patients with 10 false positive cases. The sensitivity was 100%, specificity 42.86%, PPV was 90.48%, NPV was 100% with overall accuracy of 91.11% as shown in Figure 5.

However, APGAR score showed no significant difference in both cases.

DISCUSSION

In the present study, we observed that out of total 54 cases diagnosed radiologically, 38 cases were confirmed intra-operatively for placenta accreta spectrum. The mean age observed in our study was 29.61 ± 31.2 years when compared to study conducted by Dutta et al to find out risk factors of PAS, the mean age of presentation in their study was 30.7 years. A similar study conducted by Ye et al reported mean age of 32.6 ± 4.4 years.¹³ Thus, conveying the population in our study to be slightly less or in line with other studies.

Maximum patients in our study were multiparous with mean parity of 1.82 ± 0.7 having PAS among whom 31.48%, 46.29% and 22.23% had undergone one, two and three LSCS while 31.48%, 33.3%, 22.2% and 12.96% patients had history of no, one, two and three uterine curettages respectively. Though parity and previous section significantly increased the risk of placenta accreta, history of prior curettage did not show significant association. Similar research done by Jauniaux et al concluded prior curettage as a considerable risk factor as

seen in 16.7% patients.¹⁴ While Veludandi et al suggested significant relationship with 38.1%, 50% and only 11.1% patients with history of one, two and three prior LSCS.¹⁵ In the meantime, Shi et al showed an eight fold increased risk and Srinivasan showed 82.5% patients with risk of placenta accreta syndrome with prior history of caesarean section.^{16,17}

When comparing the ultrasound and MRI findings pre operatively in our study, 75.9% and 64.40% had interruption of myometrium, 42.9% and 20% had loss of planes (retroplacental/serosal with tenting of bladder), 18.51% and 48.15% showed placental bulging, 48.14% and 87.03% showed abundant retro placental lakes with hyper intense lacunae and 55.55% and 33.33% patients showed increased vascularity with dark intraplacental bands respectively at 81.58% and hundred percent sensitivity, 42.86% specificity in both, 88.57% and 90.48% positive predictive value while 30% and hundred percent negative predictive value, respectively. Overall accuracy of ultrasonography in diagnosing PAS was observed to be 75.56% while that of MRI was 91.11%. Relatable researches were found in studies conducted by Thiravit et al and Cavalli et al.^{18,19}

Our study reckoned, intraoperative diagnosis of placenta accreta in 12.96%, increta in 24.07%, percreta in 16.67% and 29.62% with no evidence of PAS. Among these 33.3% patients underwent peripartum hysterectomy with 20% requiring additional cystorrhaphy due to bladder invasion, 48.6% were managed with haemostatic sutures, one requiring bilateral internal iliac ligation while those with no evidence of PAS were managed by caesarean section with bilateral tubal ligation. Lopes et al culminated into 87.5% hysterectomy in their study. Similar results were shown by Khalek et al and Tadayon et al where in cystotomy was inevitable in almost a quarter of the PAS group.²⁰⁻²²

Complications in terms of PPH were noted in 38.9% patients out of which 28.5% went into shock, 37.07% required ICU admission, 7.4% had wound gaping and DIC, 3.7% suffered from MODS, ARDS and SSI While 1.85% showed VVF. Maternal mortality was observed in 3.7% patients. Blood products are transfused significantly, more in cases of placenta percreta than accreta attributing to the fact that former is most severe form, causing greatest blood loss, highly leading to hysterectomy. Relatable studies on maternal outcomes were observed in study conducted by Khalek et al and Imtiaz et al in 2020.^{21,23}

When collating with neonatal outcomes, maximum delivered between 32 to 33 weeks with 44.46% cases, 14.8% cases at 34 weeks and 16.67% each at 35 and 36 weeks. 2 neonates were delivered at 29 weeks, one at 30 weeks and one at 31 weeks, making mean weeks of gestation in our study to be 33.07±1.76 weeks.

The optimal timing of delivery for patients with PAS remains controversial. Whatever the gestational is chosen,

an approach that includes the unexpected occurrence of possible cases of acute bleeding requiring an emergency caesarean section has to be planned. To decrease this risk of emergency delivery Tadayon et al reported that planned delivery at 34 to 35 weeks of gestation did not significantly increase neonatal morbidity thus proposing such patients to be delivered by caesarean hysterectomy.²²

Robinson et al conducted a study comparing strategies for the timing of delivery in individuals with placenta previa and ultrasonographic evidence of PAS to determine the optimal gestational age for delivery, which varied from a scheduled delivery at 34 to 39 weeks of gestation to delivery at 36, 37 or 38 weeks only after amniocentesis confirmation of fetal lung maturity.²⁴

In our study, the rate of lower birth weight, neonatal comorbidities (all live births in our study) and NICU requirement was comparatively lesser than other studies, such as those conducted by Tadayon et al with significantly more rates and comorbidities and Kasraeun et al with 67.27% NICU admissions.^{22,25}

Prematurity was the most common cause of neonatal ICU admission. Reason being that the effect on neonatal weight is mediated through increase in gestational age which can be improved through planned delivery whenever possible in preoperative radiologically diagnosed cases.

CONCLUSION

The main goal of the study was to compare the imaging features of ultrasound and MRI in PAS so as to diagnose all such high-risk pregnancies to provide better health facility to improve feto-maternal outcome. So, through our study, we reached a conclusion that women with advanced maternal age, multiparity, previous history of curettage or caesarean section, placenta previous were at high risk for PAS. Our study suggested slightly higher sensitivity for MRI, especially in complex cases, the equivalent specificity and resource implications uphold MRI's role as a reserved modality.

Hence, we reinforce internationally accepted models: ultrasound should remain the first line in all high-risk pregnancies- as it provides real time, low-cost placental assessment while MRI should be reserved for: inconclusive/contradictory, suspected posterior placental invasion, or extra uterine spread. Combined imaging plus clinical evaluation improves overall detection accuracy and surgical planning- but only selective MRI use is cost effective.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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