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# Diagnostic Accuracy of Doppler Ultrasound for Antenatal Detection of Placenta Accreta Spectrum (PAS) Disorders

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**Abstract:** Morbidly adherent placenta a spectrum of condition characterized by invasion of placenta to implantation site. Antenatal diagnosis of placenta accrete spectrum (PAS) is highly desirable because fetomaternal outcomes can be optimized. Diagnosis of PAS are accomplished with Doppler ultrasound. It has shown to reduce the burden of fetomaternal morbidity and mortality. The purpose of current study was to check the diagnostic accuracy of Doppler ultrasound in detection of PAS while carefully eliminating bias by controlling confounders we aimed to check the accuracy of Doppler ultrasound in detection of PAS. A cross sectional validation survey was done to find out the diagnostic accuracy of Doppler ultrasound in detection of PAS. The mean maternal age was 28.23±4.31 years. And Mean gestational age was found to be 34.3±1.82 weeks. The mean married age was 3.52±2.39 years. Parity of patients were found to be between 1-15 years with mean parity of 1.6±0.92. Out of 145 patients 3D Doppler ultrasound showed 94 positive cases while per operative findings (Gold standard) showed 90 positive cases. Sensitivity rate was found to be 86.5%, specificity was 90.24%, positive predictive value (PPV) 95.7% and negative predictive value (NPV) 72.5% and diagnostic accuracy of 87.6%.

**Keywords:** Placenta Accrete Spectrum (PAS), Feto Maternal Outcome, Positive Predictive Value

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## 1. Introduction

Morbidly adherent placenta is a condition in which all or part of placenta is adherent to uterine wall because of myometrial invasion [1]. According to International Federation of Gynecology and Obstetric (FIGO) 2018 consensus the term “Placental Accreta spectrum (PAS)” refer to all three condition (accrete, increta, percreta) [1, 2]. Morbidly adherent placenta is important etiology maternal morbidity and mortality [3]. Placental accrete Spectrum (PAS) are commonly together with placenta previa is due to uterine damage (due to previous surgery, cesarean deliveries, curettage, myomectomy) poor handling allow the placenta to grow with absent Nitabuch Layer in myomectomy [4, 5].

Gielchnisky et al (2002) found the risk factors associated with PAS were cesarean section, advance maternal age, high gravidity, multiparity previous curettage, and placenta previa. Repeated cesarean section high parity and anterior low lying placental location were associated with severe outcomes in case of PAS [6].

Diagnosis of PAS are accomplished sonography with a sensitivity of 77-87%, specificity of 96-98%, positive predictive value of 65-93% and a negative predictive value of 98% [7, 8]. Doppler ultrasound in diagnosis of PAS is 93% and specificity is 71% [9]. Initial episode of bleeding has a incidence at about 34 weeks. It occurs in over 50% of cases before 36 weeks in only 2% after 40 weeks [10]. Obstetric hemorrhage is still considered to be one of the leading cause of maternal morbidity and mortality [11]. Incidence of serious congenital malformation is double with placenta previa [12]. Ananth et al (2000) examined the independent contribution of prematurity and fetal growth restriction to low birth weight babies among women with placenta previa [13].

The approach to management included various procedures, like obstetrical hysterectomy, internal iliac arteries ligation, uterine ligation, sewing placental bed leaving placenta in situ, B Lynch suture, uterine packing, pelvic packing. wedge resection of uterus [14].

Prenatal diagnosis of PAS and planned delivery at experienced center are associated with significant reduction

in maternal and fetal morbidity [15]. In an area of advanced imaging modalities antenatal detection of PAS regrettably remains variable, as many as 20% to 50% of cases of PAS escape antenatal diagnosis [16].

## 2. Subject and Method

It is a Cross sectional validation survey conducted at Department of Obstetrics and Gynecology Unit 1 Allied Hospital, Faisalabad for period of 6 month i.e. from January 2018 to June 2018. Sample size of 145 cases were calculated by using WHO sample size calculator for sensitivity specificity. WHO manual with confidence level 95% confidence level and sensitivity 71%, specificity 93%, prevalence 82%, absolute precision 10%.

Pregnant women included in the study were those with age of 20-40 years, Primigravida to gravida 4 having single pregnancy on ultrasound with gestational age > 28 weeks on ultrasound and diagnosed cases of placenta previa major degree on ultrasound.

Pregnant women having bleeding disorders (on investigations: decreased platelets count, deranged coagulation profile.), Placental abruption (on ultrasound). Informed consent was taken from the patient and data was kept anonymous for privacy.

145 patients who presented at the department of Gynecology Obstetrics, Allied hospital Faisalabad and who fulfilled the above criteria were counseled and explained the details of the study. Written Informed consent was taken regarding usage of personal information for purpose of study. All these patients were admitted in ward and their Doppler ultrasound studies were carried out to notice placenta accreta, increta, percreta. All these patients were followed till delivery. Their surgical findings for evidence of morbidly adherent placenta (acreta, increta, percreta) were noticed and compared with Doppler ultrasound report. All surgical procedures were performed by same surgical team. All this information were entered in predesigned pro-forma. Doppler ultrasound was carried out by senior radiologist in department of Radiology AHF.

Data was entered and analyzed by SPSS version 23 computer based software program. Mean and standard deviation were calculated for age and gestational age. Diagnostic accuracy, specificity, sensitivity, positive predictive and negative predictive value were calculated by using 2×2 table 1 and surgical findings were taken as gold standard. Qualitative variable like true positive will be presented as frequency and percentages.

**Table 1.** 2×2 Table for determination of sensitivity and specificity.

	Surgical evidence +	Surgical evidence -
Doppler findings+	True positive (a)	False positive (b)
Doppler findings -	False negative (c)	False negative (d)

$$\text{Sensitivity} = a / a+c \times 100$$

$$\text{Specificity} = d / b+d \times 100$$

$$\text{Positive predictive value} = a / a+b \times 100$$

$$\text{Negative predictive value} = d / c+d \times 100$$

$$\text{Diagnostic accuracy} = a+d / a+b+c+d \times 100$$

## 3. Results

Distribution of cases by age shows, patients were between 20 - 40 years of age with mean age of 28.23±4.31 years (Table 2). Distribution of cases by gestational age shows, patient's gestational age between 30-36 weeks. Mean gestational age was found to be 34.3±1.82 weeks (Table 2). Out of 145 patients, patients were found to be married between from 1-15 years with mean married age of 3.52±2.39 years (Table 3). Parity of patients were found to be between 1-5 with mean parity of 1.6±0.92 (Table 3). Out of 145 patients 3D Doppler ultrasound showed 94 positive cases while per operative findings (Gold standard) showed 90 positive cases. Sensitivity rate was found to be 86.5%, specificity was 90.24%, positive predictive value (PPV) 95.7% and negative predictive value (NPV) 72.5% (Tables 4-6).

**Table 2.** Distribution of cases by age.

	N	Minimum	Maximum	Mean	Std. Deviation
AGE	145	20	40	28.23	4.31
gestational age	145	30	36	34.14	1.82

**Table 3.** Distribution of cases by Marital Status and Parity.

	N	Minimum	Maximum	Mean	Std. Deviation
MARRIED	145	1	15	3.52	2.39
PARITY	145	1	5	1.61	.92

**Table 4.** Comparison of Per-Operative finding vs 3D Doppler Ultrasound.

	Surgical Result		Total
	Positive	Negative	
Doppler Ultrasound Positive	90	4	94
Negative	14	37	51
Total	104	41	145

N = 145.

**Table 5.** Sensitivity, Specificity and Diagnostic accuracy of 3D Doppler Ultrasound.

Sensitivity = $\frac{a}{a+c} \times 100 = \frac{90}{104} \times 100 = 86.5\%$
Specificity = $\frac{d}{b+d} \times 100 = \frac{37}{41} \times 100 = 90.24\%$
Diagnostic Accuracy = $\frac{TP+TN}{TP+FN+FP+TN} \times 100 = \frac{127}{145} \times 100 = 87.6\%$

N = 145.

**Table 6.** Positive predicative value and negative predictive value of 3D Doppler Ultrasound.

PPV = $\frac{a}{a+b} \times 100 = \frac{90}{94} \times 100 = 95.7\%$
NPV = $\frac{d}{c+d} \times 100 = \frac{37}{51} \times 100 = 72.5\%$

N = 145.

## 4. Discussion

Placenta accrete system (PAS) is one of the serious complications in obstetrics, it occurs when the placenta is abnormally adherent to the uterus. The most severe form of the condition is placenta percreta, in which the penetrates through the full thickness of the myometrium, through the

serosa and may invade adjacent pelvic organs such as the bladder [17].

Identifying risk factors are important in emergency situations as awareness of clinical risk factors can aid in careful preoperative preparation and in counseling women with placenta previa regarding the likelihood of encountering morbidly adherent placenta with its attendant morbidity as recommended by ACOG and RCOG.

If limited to myometrium invasion, it is known as placenta increta. The etiology of morbidly adherent placenta has been thought to be due to absence of the spongy layer of deciduas and histology correspondingly shows the trophoblast invasion into the myometrium without intervening decidua. PAS can involve the entire placenta or fractions of it making the separation of placenta difficult at deli. An all too common end – result is massive hemorrhage and the need for caesarean hysterectomy [18].

The incidence of the placenta accreta is variable, and has been reported to be as high as one in 533 pregnancies, in a study by Wu et al. Risk factors of PAS include previous uterine scarring from caesarean sections, myomectomies, uterine curettages and infections. With increasing numbers of caesarean sections being now a days, it is postulated that the incidence of PAS would be on the rise.

A high index of suspicion is required for diagnosis and ultra sono graphic features suggestive of PAS must be sought in cases with risk factors [19].

Pelvic ultrasonography has been the most commonly used imaging modality for the diagnosed of PAS. LEVINE and the coworkers reported their experience with 19 women at risk of whom seven had MAP, of whom seven had morbidly adherent placenta. Ultrasonography accurately identified six of the seven women and correctly identified normal placentation in 11 of 12 cases [20].

In a larger series, Chou et al. [21], followed 80 women prospectively and of 16 considered to have ultrasound findings consistent with PAS, 14 had tissue evidence confirming the diagnosis of the remaining 64 studies interpreted as negative, placenta was adherent in three and the remainder was accurately diagnosed, resulting in a sensitivity of 82% and specificity of 96.8%. The findings of these two studies suggest that ultrasonography has a primary role in screening women at risk of PAS [21].

As a screening tool to detect PAS, the prerequisite of each individual ultrasound criterion is a sensitivity to detect more true positives in women at risk. A low sensitivity but high specific test (e.g. disrupted bladder mucosa) would result in a number of undiagnosed cases, despite the high level of confidence in recognizing true negative cases [PAS]. Given the unique clinical management of PAS, the PPV and NPV of these diagnostic measures are as important as the sensitivity and specificity. Practically, the PPV reported for each criterion in this study indicates its reliability to correctly diagnose PAS; In other words, the confidence with which clinicians can proceed straight to hysterectomy without removing the placenta. In contrast, the NPV represents the precision of diagnosis of PAS, relating to the confidence with

which clinicians can remove the placenta without concerns of severe bleeding.

According to the present study, 3D POWER Doppler ultrasonography can be used as a complementary technique for making or excluding the diagnosis of placenta accreta.

Finberg and Williamams, in their study found that gray scale ultrasound had a sensitivity of 93% and specificity of 79% [22].

The advent of Colour Doppler improved the diagnostic accuracy of conventional gray scale sonography [23-25].

Lerner and Colleagues reported a sensitivity and specificity of 100% and 94% respectively [23]

Levine and colleagues in their study found a sensitivity specificity of 86% and 92% respectively [24].

In present study, sensitivity was found to be 86.5%, specificity 90.4%, diagnostic accuracy 95%, positive predictive value 95.7% and negative predictive value 72.5%.

These findings are consistent with a study by Shih et al [26].

## 5. Conclusion

Placenta accrete system is an obstetric complication that is potentially ominous for the mother and that is currently developing the characteristics of an epidemic. This condition is one of the main causes of caesarean hysterectomy and fetomaternal morbidity and mortality. Diagnosis of this placenta accrete spectrum is based on two essential pillars: a high suspicion for disease based on the presence of risk factors, and both grey scale and colour Doppler ultrasound findings. In conclusion we believe that any persistent placenta previa, particularly in patients associated with prior cesarean section, must benefit from elaborate antenatal tranabdominal Doppler ultrasound studies to identify abnormal utero-placental vascular flow patterns. The extent and severity of hemodynamic changes of the uteroplacental circulation in placenta previa accreta must be taken into account. The identification of placenta accrete system has a positive impact on the peripartum clinical management of the affected pregnant ladies.

## Conflict of Interest

All the authors do not have any possible conflicts of interest.

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