PLACENTA ACCRETA SPECTRUM: EVALUATION OF ULTRASOUND DIAGNOSTIC CRITERIA IN AN ETHIOPIAN SETTING

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ABSTRACT

BACKGROUND: Placenta accreta spectrum (PAS) has increasingly become a major cause of obstetric hemorrhage. There is inadequate literature regarding the diagnostic accuracy of ultrasound in low-income settings such as the Sub-Saharan Africa. This study aimed to determine the diagnostic accuracy of 2D gray-scale ultrasound and color Doppler ultrasound for placenta accreta spectrum (PAS) among placenta previa cases in an Ethiopian setting

METHODS: Forty-nine cases of placenta previa that received maternity care at St. Paul's Hospital Millennium Medical College in Addis Ababa (Ethiopia) from June 2018 - October 2020 were retrospectively reviewed. A structured questionnaire was used to extract data from maternal charts. Data were analyzed using SPSS version 23. Simple descriptive statistics, and sensitivity and specificity tests were performed as appropriate. We used proportions and 95% CI to present the results.

RESULTS: Placenta accreta spectrum was detected at the time of Cesarean Delivery (CD) in 8 patients. Eight of them had complete placenta previa, 7 had anterior placenta while 1 had posterior placenta. Magnetic resonance imaging (MRI) was not done to confirm the diagnosis in all of the cases. The evaluated sonographic criteria showed good diagnostic performance: in placenta accreta spectrum (PAS) patients at least four out of five criteria were detected, with none of the criteria present in the cases without PAS. Thin myometrium was found to best predictor for the diagnosis of PAS, with high specificity and no false positive rate. Retro-placental hypoechoic space, bladder line: thinning/interruption, placental lacunae, and hypervascularity of uterine serosa–bladder interface were detected in majority of patients with PAS but there was high false positive rate.

CONCLUSIONS: In this study, the diagnostic performance of 2D and color Doppler ultrasound criteria for placenta accreta spectrum (PAS) was high. Presence of thin myometrium was found to be the single best predictor for the diagnosis of PAS. Gray scale ultrasound and color flow Doppler mapping should be used as first-line techniques for the identification of placenta accreta spectrum.

KEYWORDS: placenta accreta spectrum; PAS; Doppler ultrasound; low-income country; Sub-Saharan Africa; PPH

(The Ethiopian Journal of Reproductive Health; 2024; 16; 12-18)

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INTRODUCTION

Placenta accreta spectrum (PAS) includes the spectrum of placenta accreta, increta, and percreta and is a cause of major morbidity and mortality in pregnant women[1]. Abnormal vascularization results from the scarring process following uterine surgery with secondary localized hypoxia, leading to defective decidualization and excessive trophoblastic invasion[2]. In the last century, the incidence of PAS has risen from approximately 1 in 20,000 live births in 1928[3] to a rate of 1 in 533 in 2002[4]. This increase in the incidence of PAS has been mainly in low-middle income countries (LMICs) due to high birth and cesarean delivery rates[5]. Per a 2012 population-based study from the United Kingdom, this rate may be as low as 1.7 in 10,000 pregnancies overall but as high as 1 in 20 pregnancies in women with both placenta previa and a prior cesarean delivery[6]. An accurate prenatal diagnosis of placenta accreta spectrum (PAS) is required to reduce the risk of maternal/fetal morbidity and mortality[7]. Ultrasonography is used routinely for diagnosis of PAS, although diagnostic criteria and accuracy are still subject to debate[8,9]. Magnetic resonance imaging (MRI) can be helpful when the placenta is difficult to visualize on ultrasound due to the patient's body habitus or to a posterior location of the placenta[10,11]. Understanding the diagnostic accuracy of ultrasound for placenta accreta spectrum in low-income countries including the Sub-Saharan Africa is essential, as this diagnostic modality is cheaper and more universally available than MRI in these countries. Generating evidence on this positively impacts the care of women with PAS through timely access to a reliable diagnostic modality at an affordable cost that results in early detection of this spectrum with a planned delivery of maximum preparation. This study aimed to determine the diagnostic accuracy of 2D gray-scale ultrasound and color Doppler ultrasound for placenta accreta spectrum among placenta previa cases at a tertiary Ethiopian setting.

Methods and Materials

Study design, study setting, and study period

This retrospective review examined cases of placenta previa that received maternity and obstetric care at St. Paul's Hospital Millennium Medical College (SPHMMC) in Addis Ababa, Ethiopia, from June 2018 to October 2020. We evaluated the diagnostic accuracy of 2-D ultrasound and doppler ultrasound in diagnosing placenta accreta spectrum. SPHMMC is a tertiary and national referral Hospital in Ethiopia with various specialty and sub-specialty care and training programs, including Maternal-fetal medicine. Monthly, 850–950 deliveries are attended at the hospital, which is one of the highest in Ethiopia[12].

The inclusion criteria were mothers who delivered at St. Paul's Hospital; who had initial conservative management in our maternity ward; placenta previa cases (including low-lying placenta) who had detailed obstetric ultrasound that documented placenta location and presence/absence of placenta accreta spectrum; The exclusion criteria were incomplete data.

Sample size and sampling procedure

All the cases managed during the study period according to inclusion and exclusion criteria were included were included.

Data collection

We reviewed medical records of placenta previa cases admitted to our maternity ward for conservative management. A structured questionnaire was used to extract data on reproductive characteristics, obstetric ultrasound and intra-operative findings, and maternal outcomes from maternal charts. using the results of 2D gray-scale transabdominal or transvaginal ultrasonography and color Doppler documented in the maternal chart, we retrospectively investigated the loss or irregularity of the echolucent area between the uterus and the placenta ('clear space'), thinning or interruption of the hyperechoic interface between the uterine serosa and the bladder wall and the presence of turbulent placental lacunae, myometrial wall thickness, and hypervascularity of the uterine serosa–bladder

interface. Ultrasound was performed by obstetrics and gynecology senior residents, maternal-fetal-medicine fellows and Ob-Gyn consultants. We had no aim of comparing the diagnostic skills difference among the physicians.

Data analysis

Data was analyzed using SPSS version 23. Simple descriptive statistics was used to analyses baseline characteristics, obstetric characteristics, and treatment outcomes. Ultrasound findings were reviewed against the final diagnosis made during Cesarean section (CS). We performed also validity test-diagnostic sensitivity and specificity of the ultrasound criteria analyzed.

Ethical clearance

Formal Ethical clearance letter was obtained from Institutional review board of St. Paul Hospital Millennium Medical College with a reference number PM23/693. The ethical clearance did not require obtaining informed consent from study subjects; hence it was not obtained from the participants of this study.

Results

There were 49 cases of placenta previa cases during the study period. None of the cases had an MRI imaging. The mean gestational age at delivery was 36 weeks(Table-1). Majority of them (67%) had no history of previous CS scar and had posterior placentation (26/49). Twenty-eight were compete placenta previa cases while the rest were low-lying placenta previa cases. Out of these, there were 8 cases of placenta accreta spectrum (PAS) among 49 cases and all of them had complete placenta previa and previous Cesarean Section (CS) scar and were managed with classical CS and peripartum hysterectomy.

Table 1: Baseline characteristics of placenta previa cases in Ethiopia, 2018-2020(N=49)

Characteristics	Category	N	Percent
Maternal age	Mean	27.35	
Number of prior CS scar	No scar	33	67.3
	1	6	12.2
	2	7	14.3
	3	3	6.1
Previous surgical abortion	No	43	87.8
	Yes	6	12.2
Morbidly adherent placenta	No	41	83.7
	Yes	8	16.3
Placenta previa type	Complete placenta previa	28	57.1
	Low-lying placenta	21	42.9
Placenta location	Anterior	23	46.9
	Posterior	26	53.1
Indication for delivery	Elective delivery due date	29	61.7
	Recurrent bleeding	1	2.1
	Active bleeding	11	23.4
	Labor onset	5	10.6
	Emergency fetal indication	1	2.1
Mode of delivery	Lower uterine s egment C/S	41	83.7
	Classic CS	8	16.3
Gestational age at delivery(Weeks)	Mean	36	
	No complication	43	87.8
Maternal complication	PPH	3	6.1
	PPH with massiven blood transfusio	3	6.1

In seven out of the eight cases of placenta accreta spectrum, the placenta was anterior(Table-2). Three cases had PPH, while another 3 cases had torrential bleeding which required massive blood transfusion. Only 3 out of eight had pathology results which revealed placenta accreta spectrum (2 placenta accreta and 1 placenta percereta).

Table 2: Clinical characteristics of placenta accreta spectrum(PAS) cases (n=8), 2018-2020, Ethiopia

Variables	Category	N	Percent
Number of prior CS scar	1	3	37.5%
	2	4	50.0%
	3	1	12.5%
Placenta previa type	Complete placenta previa	8	100.0%
Placenta location	Anterior	7	87.5%
	Posterior	1	12.5%
Maternal complication	Peripartum hysterectomy	2	25.0%
	Peripartum hysterectomy + PPH	3	37.5%
	Peripartum hysterectomy +PPH +massive blood transfusion	3	37.5%
Pathology report	placenta accreta spectrum	3	37.5%
	No pathology report	5	62.5%

Analysis of sonographic criteria showed good diagnostic performance (Table-3); in PAS patients at least four criteria were detected (Table-4), with none of the criteria detected in patients without PAS. Thin myometrium (lower uterine segment myometrium thickness of less than 1 mm) was found to be the best predictor for PAS (Sensitivity=62.5%, Specificity=100%, PPV=100%, and NPV = 95%). Retro placental hypoechoic space, bladder line: thinning/interruption, placental lacunae, and hypervascularity of uterine serosa–bladder wall interface were detected in majority of patients with PAS but with a relatively high false positive rate (12.5%).

Table 3: Statistical evaluation of sonographic diagnostic criteria for placenta accreta spectrum among placenta previa patients, 2018-2020, Ethiopia

Ultrasound criteria	Status	N	Sensitivity	Specificity	PPV	NPV
			% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Retro placental hypoechoic space	Absent	7	87.5 (64, 100)	97.6 (87, 100)	87.5 (64, 100)	97.6 (93, 100)
	Present	42				
Bladder line: thinning/interruption	Present	6	75 (44, 100)	97.6 (87, 100)	85.7 (59, 100)	97.6 (89, 100)
	Absent	43				
Placental Lacunae	Present	7	87.5 (64, 100)	97.6 (87, 100)	87.5 (64, 100)	97.6 (93, 100)
	Absent	42				
Hypervascularity of uterine serosa–bladder wall interface	Present	7	87.5 (64, 100)	97.6 (87, 100)	87.5 (64, 100)	97.6 (93, 100)
	Absent	42				
Myometrium thickness	Thin	5	62.5 (28, 97)	100 (100, 100)	100 (100, 100)	95.3 (89, 100)
	Normal	44				

Table4: Number of Ultrasound criteria among placenta accreta spectrum cases

Diagnosis	US criteria(n)	N	%
Placenta previa	0	41	83.7%
Placenta accreta spectrum	4	4	8.2%
	5	4	8.2%

DISCUSSION

The main objective of this study was to determine the diagnostic accuracy of 2D and color Doppler ultrasound criteria for the diagnosis of placenta accreta spectrum. We found high diagnostic performance of 2D and color Doppler ultrasound criteria for diagnosis of morbidly adherent placenta (MAP). Out of the ultrasound criteria we evaluated, thin myometrium was found to be the single best predictor for the diagnosis of PAS with high sensitivity, specificity, negative predictive value, and positive predictive value.

Ultrasound evaluation with grayscale and color Doppler imaging is the recommended first-line modality for diagnosing placenta accreta spectrum (PAS)[13]. According to a recent systematic review of 23 studies (3,707 pregnancies), ultrasound has an average sensitivity of 90.72% (95% CI, 87.2–93.6) and specificity of 96.94% (95% CI, 96.3–97.5%) for the diagnosis of PAS[14].

Diagnostic criteria that suggested placenta accreta, increta, or percreta include ≥1 of the following situations: (a) placental lacunae; obliteration of clear space; interruption of bladder border; myometrium of less than 1 mm; hypervascularity of uterine serosa–bladder wall interface[15-17]. In the present study, consistent with findings of previous studies, retro placental hypoechoic space, bladder line: thinning/ interruption, placental lacunae, thin myometrium, and hypervascularity of uterine serosa–bladder wall interface were found to be helpful in the diagnosis of morbidly adherent placenta[18]. Similarly, Cal`ı et al in 2013 found that these ultrasound criteria were useful in prenatal diagnosis of PAS[19]. Tovbin et al and colleagues also found that a scoring system using the same ultrasound criteria is highly predictive of MAP in patients at risk[20]. According to recent literature, from the ultrasound criteria, multiple lacunae and turbulent flow are strongly associated with placenta accreta spectrum[21-23]. This is further supported with findings of a recent multicenter cross-sectional study done in 2019, which similarly showed that irregularly shaped placental lacunae, turbulent blood flow through the lacunae, and protrusion of the placenta into the bladder were the best predictors of morbidly adherent placenta[24]. On the contrary, a recent study done in Kuwait found that disruption of uterine serosa– bladder interface (81.8% sensitivity), exophytic mass invading bladder (94.9% specificity, 66.7% positive predictive value (PPV), and 84.1% negative predictive value [NPV]), and disruption of uterine serosa–bladder interface as the best parameters for the diagnosis of morbidly adherent placenta[25]. In this study, unlike in none of these previous study, thin myometrium (lower uterine segment myometrium less than 1 mm thick) was the best predictor of morbidly adherent placenta (Specificity=100%, PPV=100%, and 95% NPV). Furthermore, loss of retro placental hypoechoic space had high sensitivity (87.5%) in diagnosing placenta accreta spectrum (PAS) in our study, which is consistent previous reports and with findings of a recent study done in Egypt that reported a sensitivity of 86.96% for the same ultrasound criteria[26].

Small sample size with no proper sample allocation is the main limitation of our study. Retrospective data collection and incomplete pathology report for all cases of placenta accreta spectrum are the other limitations of this study. In addition, we were not able to categorize ultrasound diagnostic accuracy according to the level of expertise (ultrasound performed by post-graduate students vs. Obstetricians and maternal fetal medicine specialists) and we did not compare diagnostic accuracy of ultrasound with that of MRI. Last but not least, this study lacks description of the role of multi-disciplinary team approach in the management of morbidly adherent cases (senior obstetricians, gynecologic oncologists, and urologists).

Conclusion

The diagnostic performance of 2D and color Doppler ultrasound criteria for placenta accreta spectrum (PAS) was good. Presence of thin myometrium was found to be the single best predictor for the diagnosis of PAS. Gray scale ultrasound and color flow Doppler mapping should

be used as first-line techniques for the identification of morbidly adherent placenta.

Ethical consideration

Formal Ethical clearance letter was obtained from Institutional review board of St. Paul Hospital Millennium Medical College with a reference number PM23/693. The ethical clearance did not require obtaining informed consent from study subjects; hence it was not obtained from the participants of this study.

AUTHOR CONTRIBUTIONS

AFS and WG contributed conception and development of the study protocol. AFS and WG contributed data collection. AFS performed the data analysis. AFS, AN and WG contributed data interpretation and manuscript write up. All authors critically revised the article for intellectual content. All authors reviewed the final manuscript and approved its submission for publication.

Conflicts of Interest

Authors report no conflicts of interest

Funding statement

No funding was received for this study

DATA AVAILABILITY STATEMENT

Data are available up on reasonable request from authors

ACKNOWLEDGMENTS

We would like to acknowledge the department of Obstetrics and Gynecology at St Paul's Hospital Millennium Medical College (SPHMMC)

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