

# Diagnostic Role of Doppler Ultrasound in Morbidly Adherent Placenta (MAP): An Obstetrical Emergency

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## Abstract

**Objective:** To determine the diagnostic role of Doppler Ultrasound in morbidly adherent placenta (MAP) in patients with previous caesarean sections, keeping operative finding as gold standard.

**Study Design:** Cross sectional, Descriptive study.

**Setting and Duration:** The study was conducted at the Department of Radiology Dow Medical College and Civil Hospital Karachi from December 2015 to October 2016.

**Methodology:** This study enrolled 446 gravid females with previous history of Caesarean Sections. All of these patients referred to the Radiology Department for Obstetrical and Doppler Ultrasound. Ultrasound scan findings were interpreted by senior Sonologist / Radiologist followed by per operative (Caesarean Section) findings which were recorded from surgical/operative notes. Data was entered and analyzed by using SPSS version 21. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of Doppler ultrasound were calculated. Stratification was done to observe effect of modifiers on the accuracy through chi-square test and hence  $P \leq 0.05$  was considered as significant.

**Results:** The mean age was  $31.4 \pm 4.93$  years. The mean gestational age was  $31.8 \pm 2.7$  weeks and the mean numbers of previous Caesarean Sections were  $2.94 \pm 0.94$ . Sensitivity, Specificity, PPV, NPV and accuracy were 95.9%, 88.2%, 94.0%, 91.8%, and 93.3% respectively.

**Conclusion:** This study concluded a higher diagnostic accuracy of transabdominal Color Doppler ultrasound for the diagnosis of morbidly adherent placenta. It is a very useful, safe and easily available modality for evaluation of potentially life threatening obstetric disorder.

**Keywords:** Diagnostic Accuracy, Doppler Ultrasound, Morbidly Adherent Placenta, MAP, Previous caesarean section, per operative Finding.

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## Introduction

Morbidly adherent placenta (MAP) is a significant cause of maternal morbidity, mortality, massive obstetric hemorrhage and potentially life threatening condition.<sup>1</sup> By definition, Morbidly adherent placenta (MAP) is in abnormal placental attachment

/adherence; either in whole or in part of the placenta to the underlying uterine wall.<sup>2</sup> It has Different types that depends on myometrial invasion includes placenta accreta, percreta and increta.<sup>3</sup>

It is found to be the third most common indication for

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emergency obstetrical hysterectomy next to uterine rupture and atony in Pakistan.<sup>4</sup> With the growing rate of Caesarean deliveries there is increased frequency of having morbidly adherent placenta, particularly placenta accreta.<sup>5</sup> It is about 8.7 fold increase in previous caesarean patient.<sup>6</sup>

The incidence of MAP has increased drastically over the last three decades.<sup>7</sup> The frequency of abnormal placentation is increasing day by day in women with abnormal localization of placenta especially placenta previa, which is increased to 10 fold.<sup>8</sup> The statistics showed that the Placenta percreta constitutes around 5% of MAP, increta constitutes 15% and accreta about 80%.<sup>8</sup>

The antenatal Grey scale Ultrasonography along with color Doppler studies have shown to be highly effective in the detection of placenta accreta, when applied to clinically high risk patients such as those with previous uterine surgeries or caesarean sections.<sup>9</sup> Ultrasound is considered to be the initial imaging modality of choice in antenatal period amongst the various diagnostic methods.<sup>1</sup> Myometrial involvement greater than 1mm with large placental lakes on Doppler ultrasound predicts myometrial invasion. Color and power Doppler provides a higher specificity in the diagnosis of placenta accreta and it helps to determine the depth of myometrial invasion. There are different methods to determine the morbidly adherent placenta on ultrasound.

1. A turbulent blood flow extending from the placenta into the surrounding tissues.
2. Focal or diffuse parenchymal placental lacunar flow.
3. Vesicouterine serosa interphase hypervascularity.
4. Prominent retro placental venous complex and;
5. Loss of retro placental Doppler vascular signals.<sup>10</sup>

The serious complication of morbidly adherent placenta is maternal hemorrhage leading to maternal as well as perinatal death. The diagnosis of MAP is certainly a great challenge; our aim is to decrease morbidity of this progressively increasing obstetric complication by early diagnosis that helps in appropriate timely management that ultimately reduces the maternal and perinatal mortality<sup>12,13</sup>. Doppler ultrasound represents milestone in the diagnosis of abnormal placentation and extent of myometrial involvement.<sup>11</sup>

Over the last decade, Ultrasound (USG), magnetic resonance imaging (MRI) or a combination of these two modalities are utilized depending on the availability of equipment and expertise. As Ultrasound is readily available, low cost with no radiation hazards and it is the investigation of choice for placental localization, placental abnormalities and its variants.

Previous local research has been done but there is limited data available with small sample size on diagnostic accuracy of Doppler ultrasound in morbidly adherent placenta.

Gray scale and color Doppler ultrasound imaging have been shown to be effective imaging approach for the detection of morbidly adherent placenta. This would help us in understanding the role of this modality for early diagnosis and afterward appropriate management of the patients.

## Methodology

This cross sectional study was conducted in the Department of Radiology DMC / Civil Hospital Karachi, from December 2015 to November 2016. It is estimated as 446 patients using 95% confidence level, with expected percentage of sensitivity 97%, specificity of 88.5% and desired precision of 3%. The sampling technique was Non-probability consecutive.

This study included 446 gravid patients of 20 to 40 years of age with history of previous Caesarean section, Gravida >1, singleton pregnancy and Gestational age > 28 weeks on ultrasound. Exclusion Criteria were maternal bleeding disorders (labs show decreased platelets count, deranged coagulation profile) and Placenta abruption on ultrasound.

After taking approval from ethical committee, patients meeting the above mentioned inclusion criteria, referred from the Obs. and Gynae department for Doppler Ultrasonography to the Radiology department of Civil Hospital Karachi were included. Purpose and procedure of study was explained including the risks and benefits. After taking an informed consent. Doppler ultrasonography was performed according to departmental protocol by using Toshiba xario 100 with high frequency convex probe. All examinations were performed by senior consultant Sonologist/ Radiologist with at least 5 years' experience in Doppler Ultrasound. Sonographic criteria for the presence or absence of Morbidly adherent placenta (MAP)(according to operational definition) were followed and findings were

confirmed with preoperative findings from relevant obstetrician.

**Operational Definition:**

**Morbidly Adherent Placenta (MAP):**

Morbidly adherent placenta is the abnormal implantation of placenta into the uterine wall in which the placental trophoblast invades the endometrium due to defect in decidua basalis.

**Morbidly Adherent Placenta Findings on Doppler Ultrasound:**

Any one of the following findings of morbidly adherent placenta can be present:

- a) Diffusely dilated vascular channels scattered throughout the placenta and surrounding myometrial or cervical tissue, which show high velocity pulsatile venous type flow in sonolucent vascular spaces.
- b) Abnormal blood vessels linking the placenta to bladder with high diastolic arterial blood flow.
- c) Markedly dilated peripheral sub placental vascular channels with pulsatile venous type flow over the uterine cervix.
- d) Vessels crossing placental tissue disruption.
- e) Abnormal clear space and uterine serosa bladder wall interface hypervascularity.

**Intraoperative Findings of Morbidly Adherent Placenta:**

Any one of the following findings of morbidly adherent placenta can be present:

- a) Blood vessels invading myometrium.
- b) Loss of plane of cleavage between uterus and placenta.
- c) Invasion of vessels into adjacent structures eg bladder.
- d) Placenta not separated.

True positive: Cases with Doppler ultrasound findings positive for morbidly adherent placenta and confirmed by intraoperative findings.

True negative: Cases with Doppler ultrasound findings negative for morbidly adherent placenta confirmed on intraoperative findings.

False Positive: Cases with Doppler ultrasound findings positive for morbidly adherent placenta but normal on intraoperative findings.

False Negative: Cases with Doppler ultrasound findings negative for morbidly adherent placenta but positive on intraoperative findings.

**Data Analysis Procedure:** A data base was developed on SPSS for windows version 21.0 mean value and standard deviation were calculated for quantitative variables like age, gestational age and qualitative variables like parity, gravidity, number of previous C-section and presence of morbidly adherent placenta. The diagnostic accuracy of Doppler Ultrasound of morbidly adherent placenta was calculated in terms of sensitivity, specificity, positive predictive values and negative predictive value using intraoperative findings as gold standard. Effect modifiers were controlled through stratification of age, parity, number of previous C-section, gravidity and gestational age to see the effect of these on outcome variables. Post stratification applying chi square test taking p value less than or equal to 0.05 as significant.

Doppler ultrasound		Morbidly adherent placenta findings intraoperatively	
		Positive	Negative
Morbidly adherent placenta Doppler ultrasound	Positive	True positive (a)	False positive (b)
	Negative	False negative (c)	True negative (d)

**Sensitivity:** Number of cases with Doppler ultrasound findings of morbidly adherent placenta confirmed on intraoperative findings (gold standard) divided by total number of cases found to have morbidly adherent placenta found intraoperatively multiplied by 100.

$$(TP / TP+FN) \times 100$$

**Specificity:** Number of cases negative for morbidly adherent placenta on Doppler ultrasound confirmed by intraoperative findings (gold standard) divided by total number of cases negative for morbidly adherent placenta found intraoperatively multiplied by 100.

$$(TN / TN+FP) \times 100$$

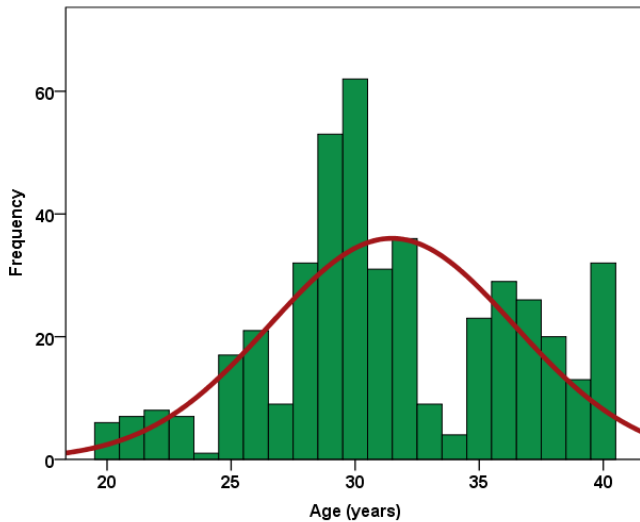
**Diagnostic Accuracy:** The number of true positive morbidly adherent placenta cases and true negative morbidly adherent placenta cases divided by total number of cases multiplied by 100.

$$(TP + TN / TC) \times 100$$

**Results**

The mean age was 31.48±4.93 years. The distribution of age is presented in Figure-1. The age was stratified

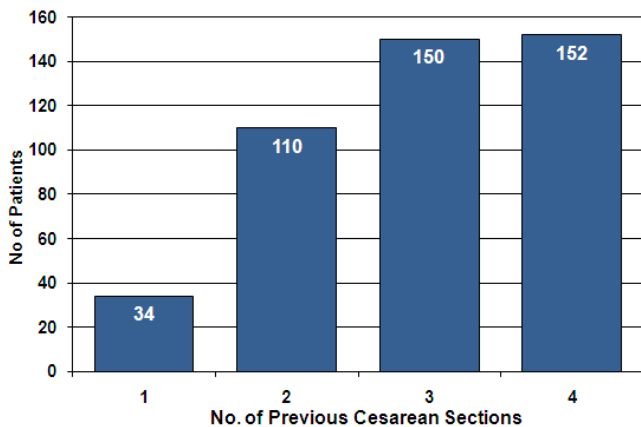
in two groups, 193(43.3%) patients were aged  $\leq 30$  years and age of 253(56.7%) patients was  $>30$  years.



**Figure 1. Histogram Presenting Distribution of Age in years(n=446)**

The mean gestational age was  $31.81 \pm 2.71$  weeks. The gestational age was stratified in two groups. The gestational age of 218(48.9%) patients was  $\leq 37$  weeks and this was  $>37$  weeks in 228(51.1%) patients.

The mean number of previous caesarean sections was  $2.94 \pm 0.94$ . The number of previous caesarean section was stratified in two groups, 294(65.9%) patients previously had  $\leq 3$  caesarean sections and 152(34.1%) patients had  $>3$  caesarean sections. The frequency distribution of number of caesarean section is presented in Figure-2.



**Figure 2. Frequency distribution of no. of previous caesarean section (n=446)**

The mean gravidity was  $4.04 \pm 1.18$ . The gravidity was stratified in two groups, 337(75.6%) patients had gravidity  $\leq 4$  and 109(24.4%) patients had gravidity  $>4$ .

Among total 446 patients, it was observed that with Doppler ultrasound findings in morbidly adherent placenta was found positive in 300 patients. The frequency distribution is presented in Table I. With Intra-operative findings morbidly adherent placenta was found positive in 294 patients.

Sensitivity, Specificity, Predictive values and diagnostic accuracy of Doppler ultrasound for the diagnosis of morbidly adherent placenta taking intra-operative findings as gold standard were calculated. The results showed that there were 282 patients were true positive, correctly diagnosed and 134 patients were true negative, correctly diagnosed. Sensitivity, Specificity,

**Table I: Diagnostic Accuracy of Doppler Ultrasound Findings to Diagnose Morbidly Adherent Placenta with Intra-Operative Findings as Gold Standard (n=446)**

Doppler Ultrasound Findings	Intra-Operative Findings		TOTAL	P-value
	Positive (n=294)	Negative (n=152)		
<b>Positive</b> (n=300)	282	18	<b>300</b>	<b>0.000*</b>
<b>Negative</b> (n=146)	12	134	<b>146</b>	
<b>TOTAL</b>	<b>294</b>	<b>152</b>	<b>446</b>	
<b>Sensitivity</b>	<b>95.9%</b>	<b>88.2%</b>	<b>94.0%</b>	<b>91.8%</b>
<b>Specificity</b>	<b>88.2%</b>	<b>94.0%</b>	<b>91.8%</b>	<b>93.3%</b>

PPV, NPV and accuracy were 95.9%, 88.2%, 94.0%, 91.8%, and 93.3% respectively. These results are also presented in Table I.

Chi Square Test Was Applied To Check Association P-Value  $\leq 0.05$  Considered As Significant.\* Highly Significant At 0.01 Levels

## Discussion

The Obstetrical Doppler ultrasound plays a vital role in initial detection that helps obstetrician in the appropriate management of morbidly adherent placenta (MAP). Ultrasound is a safe, low cost imaging modality that might completely replace the high cost modality MRI especially in under developed countries. MAP is an obstetrical emergency and life threatening condition that needs proper timely diagnosis and management.<sup>14</sup>

In under developed countries with low literacy rate, poverty and lack of awareness on family planning, a number of pregnancies increased which raised the clinical risk factors which include placenta previa, abnormal adherent placenta, uterine surgeries and caesarean section. It complicates around 0.9% of all the pregnancies.<sup>15,16</sup> As the number of caesarean

deliveries increases, chances of abnormal placental implantation / morbidly adherent placenta also increases.<sup>17</sup>

In this current study, 193(43.3%) were between 20 - 30 years, 253(56.7%) were 30 years, mean SD was calculated as 31.48+2.65 years. 337(45.6%) were Para 4 and 109(24.4%) had >4 Para, frequency of morbidly adherent placenta (as per operative findings) reveals in 294(65.59%) and diagnostic accuracy of color Doppler ultrasound in antenatal diagnosis of MAP in gravid females with previous caesarean deliveries was calculated as, 95.9%, 88.2%, 94.0%, 91.8% and 93.3% as sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate respectively.

These findings are supported by other studies who reported that color Doppler US has a sensitivity of between 82.4% and 100% and 91.2% specificity between 92% and 96.8%.<sup>18</sup>

Our study results are also comparable to D. Khalid study in which, 41(59.42%) were between 18 - 30 years, 28(40.58%) were between 31-35 years, mean was calculated as 27.78+2.65 years, 33(47.83%) between 13 and 36(52.17%) had >3 paras, frequency of morbidly adherent placenta (as per operative findings) reveals in 8(11.59%) cases.

Diagnostic accuracy of color Doppler ultrasound in antenatal diagnosis of MAP in gravid females having placenta previa was calculated as 87.5%, 98.36%, 87.5%, 98.36% and 97.10% as sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate respectively.<sup>19</sup>

The expected prevalence of ultrasonography in detecting MAP was 82%. Warshak CR and Wong HS<sup>20</sup> observed that anterior lower uterine segment is the most common site for placenta accreta and due to its superficial location, Color Doppler Ultrasound is useful in demonstrating placental blood flow into the bladder interface.<sup>20</sup>

The sensitivity of Doppler ultrasound is variable and ranges from 85 to 100% and its specificity from 35 to 96%, depending on the study.<sup>21,22</sup> Three recently published systematic reviews have shown the diagnostic accuracy of ultrasound for the diagnosis of invasive placentation,<sup>22</sup> the use of MRI and a comparison of ultrasound and MRI.<sup>23</sup> D'Antonio et al published meta analyses for diagnosis of invasive placentation with sensitivity of 90.7% and specificity of 96.9% for ultrasound and sensitivity of 94.4% and

specificity of 84% for MRI.<sup>23,24</sup> Meng et al showed that ultrasound's sensitivity was 83%, its specificity was 95% and diagnostic odds ratio (DOR) was 63.41 compared to 82%, 88% and 22.9% respectively, for MRI. These Meta analyses showed good accuracy of ultrasound and MRI in the diagnosis of invasive placentation.

Color Doppler ultrasound is a widely used imaging modality for the antenatal screening of placenta localization and placental abnormalities because it is cost effective, readily available and safe. Color Doppler ultrasound has high sensitivity and specificity for the diagnosis of morbidly adherent placenta; specific defined criteria are used as mentioned in operational definition.<sup>25</sup> The results of this study in support with other studies reveal that diagnostic role of color Doppler ultrasound in antenatal diagnosis of morbidly adherent placenta in gravid females with previous H/O caesarean deliveries are significantly high and this modality may be used further for timely management.

## Conclusion

Our study concluded that Color Doppler ultrasound has high sensitivity, specificity, PPV, NPV and diagnostic accuracy. Therefore it is recommended as a diagnostic modality of choice for prenatal diagnosis of morbidly adherent placenta especially in high risk patients. Doppler ultrasound is less expensive, noninvasive, accurate, and time-saving modality. Prenatal diagnosis allows time for a multidisciplinary team to make delivery plans, which will help decrease life threatening obstetrical complications.

**LIMITATION:** The study was conducted with a small sample size hence more structured studies with larger sample are required to be carried out to standardize the diagnostic procedure. This study was a single-center experience. Another limitation of this study was that it was conducted in urban population, therefore; the results might not be generalized to a larger rural population.

## References

1. Afia, Usmani SA, Rana T, Bano B. Diagnostic accuracy of doppler ultrasound for antenatal detection of morbidly adherent placenta. *J Fatima Jinnah Med Coll.* 2014;8(1):85-88.
2. Hasan AA, Hasan J, Khan AA. Management and maternal outcome in morbidly adherent placenta. *J Surg Pak.* 2009;14:1669.
3. Derman AY, Nikas V, Haberman S, Zalenko N, Opsha O, Flyer M. Clinical perspective: MRI of placenta accreta: a new imaging perspective. *Am J Roentgenol.* 2011;197(6):1514-1521.
4. Shah N, Khan NH. Emergency obstetrical hysterectomy :review of 69 cases. *Rawal Med J.* 2009;34(1):75-78.

5. Riteau SA, Tassin M, Chambon G, Valliant LC, Laveaucoupet DJ, Quere PM, et al. Accuracy of ultrasonography and magnetic resonance imaging in diagnosis of placenta accreta. *PLoS One*. 2014;9(4):e94866.
6. Aggarwal R, Suneja A, Vaid BN, Yadav p, Sharma A, Mishra k. Morbidly adherent placenta. *J Obstet Gynecol India*. 2012;62(1):57-61.
7. Leyendecker JR, Du Bose M, Hossein zadeh K, Stone R, Gianini J, Childs DD et al. MRI of Pregnancy-Related Issues: Abnormal Placentation. *Am J Roentgenol*. 2012;198(2):311-320.
8. Eller AG, Bennett MA, Sharshiner M, Masheter C, Soisson AP, Dodson M, et al. Maternal morbidity in cases of placenta accreta managed by a multidisciplinary care team compared with standard obstetric care. *Obstet Gynecol*. 2011;117(2 part 1):331.
9. Shih JC, Palacios Jaraquemada JM, Su YN, Shyu MK, Lin CH, Lin SY. Role of three dimensional power Doppler in antenatal diagnosis of placenta accrete. Comparison of gray scale and color Doppler Ultrasound *Obstet Gynecol*. 2009;33(2):193-203
10. Cheung SC, Chan CB. The sonographic appearance and obstetric management of placenta accrete. *Int J Womens Health*. 2013;4: 587-94.
11. Wong SH, Heung KY, WILLIAMS E. Antenatal ultrasound assessment of placental/myometrial involvement in morbidly adherent placenta. *Aust N Z J Obstet Gynecol*. 2012;52(1):67-72.
12. Doumouchtsis SK, Arulkumaran S. The morbidly adherent placenta: an overview of management options. *Acta Obstet Gynecol Scand* 2010; 89(9): 1126-1133.
13. Oyelese Y, Smulian JC, Placenta previa, placenta accreta, and vasa previa. *Obstet Gynecol* 2006; 107(4): 927-941.
14. Elhawary TM, Dabees NL, Youssef MA; Diagnostic value of ultrasonography and magnetic resonance imaging in pregnant women at risk for placenta accreta. *J Matern Fetal Neonatal Med*. 2013;26(14):1443-1449
15. Gielchinsky Y, Rojansky N, Fasouliotis SJ, Ezra Y, Placenta accreta – summary of 10 years: a Survey of 310 Cases. *Placenta*. 2002; 23: 210-214.
16. Miller DA, Chollet JA, Goodwin TM, Clinical risk factors for placenta previa-placenta accreta. *Am J Obstet Gynecol*. 1997; 177(1): 210-421.
17. Cali G, Giambanco L, Puccio G, Forlani F. Morbidly adherent placenta: evaluation of ultrasound diagnostic criteria and differentiation of placenta accreta from percreta. *Ultrasound in obstetrics & gynecology*. 2013 ;41(4):406-412.
18. Maher MA, Abdelaziz A, Bazeed MF. Diagnostic accuracy of ultrasound and MRI in the prenatal diagnosis of placenta accreta. *Acta Obstet Gynecol Scand*. 2013;92:1017–22.
19. D Khalid, A Noreen, A Mehmood, M Zahra, M Gul, A Shakir, Diagnostic Accuracy of Color Doppler Ultrasound in Antenatal Diagnosis of Morbidly Adherent Placenta. *PJMHS*. 2016;10(2):478-481.
20. Wong HS, Zuccollo J, Straw L. The use of ultrasound in assessing the extent of myometrial involvement in partial placenta accreta. *Ultrasound Obstet Gynecol* 2007;30:277-230.
21. Riteau A-S, Tassin M, Chambon G, Le Vaillant C, de Laveaucoupet J, Quéré M-P, et al. Accuracy of Ultrasonography and Magnetic Resonance Imaging in the Diagnosis of Placenta Accreta. *PLoS ONE*. 2013;9(4):e94866.
22. D Antonio F, Iacovella C, Bhide A. Prenatal identification of invasive placentation using ultrasound: systematic review and meta-analysis. *Ultrasound Obstet Gynecol*. 2013;42(5):509–517.
23. D'antonio F, Iacovella C, Bhide A. Prenatal identification of invasive placentation using ultrasound: systematic review and meta-analysis. *Ultrasound in Obstetrics & Gynecology*. 2013 ;42(5):509-517.
24. Meng X, Xie L, Song W. Comparing the diagnostic value of ultrasound and magnetic resonance imaging for placenta accreta: a systematic review and meta-analysis. *Ultrasound Med Biol*. 2013;39:1958–965.
25. Peker N, Turan V, Ergenoglu M, Yeniel O, Sever A. Assessment of total placenta previa by magnetic resonance imaging and ultrasonography to detect placenta accreta and its variants. *Ginekol Pol*. 2013;84(3):186–189.