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Role of Color Doppler Ultrasound in Prediction of Adherent Placenta Previa

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Abstract –

Introduction: Adherent placenta is a decidualisation disorder that includes placenta accreta, increta, and percreta. They are uncommon but potentially life-threatening conditions due to the risk of massive hemorrhage that may warrant hysterectomy. Risk factors include age, multiparity, previous uterine scar and placenta previa. Prediction of adherent placenta is possible using color Doppler ultrasonography.

The aims of this study are to describe the pattern of adherent placenta among cases of placenta previa and to investigate diagnostic performance of abdominal ultrasound scanning and Doppler ultrasound in diagnosis of adherent placenta among placenta previa.

Materials and methods: A prospective study over a 4-month period from August 2016 – November 2016 with institutional ethical approval was conducted in Benghazi Medical Centre, Libya. Ninety-one women with placenta previa complicated pregnancies, who had Doppler ultrasound at 36 weeks gestation, were included in the study.

Results: Of 91 cases of placenta previa, 16.5% among them were adherent. Risk factors for adherent placenta in placenta previa only included the history of previous scars as more cesarean sections was significantly related to the occurrence of adherent placenta (P = 0.029). Presence of previous scar confers a high sensitivity (86.7%) and a high negative predictive value (94.3%). Doppler ultrasound predicted adherent placenta with different signs, the most sensitive being retroplacental hypervascularity and placenta covering the os (86.7%) while serosal disruption was the most specific sign (100.0%). The highest overall test performance signs were serosal disruption (89.0%), followed by presence of lacunae and absence of retroplacental clear zone (both 85.7%).

Conclusion: Placenta previa confers high risk for adherent placenta, with 16.5% of cases of placenta previa having adherent placenta. Doppler ultrasound predicted adherent placenta with different signs, the most sensitive being retroplacental hypervascularity and placenta covering the os while serosal disruption was the most specific sign. Further well-designed research investigating abnormal decidualisation disorders and factors related to adherent placenta is required.

Keywords – Placenta Praevia, Color Doppler, Placenta Accrete.

I. INTRODUCTION

Massive obstetric haemorrhage is still the leading cause of pregnancy-related deaths, and placenta previa accreta remains one of the major predisposing factors [1,2]. With the increasing rate of caesarean delivery, the incidence of both placenta previa and placenta accreta is steadily increasing in frequency [3,4]. It is therefore anticipated that more cases of placenta previa accrete will be seen in our obstetric practice. In several recent studies, placenta accreta has emerged as the major indication for peripartum hysterectomy, accounting for 40–60% of cases [3-5]. It has, therefore, become a challenging problem of increasing clinical significance in obstetrics.

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Placenta accreta is a general term which includes placenta accreta, placenta increta and placenta percreta [6]. Placenta accreta is considered a severe pregnancy complication that may be associated with massive and potentially life-threatening intrapartum and postpartum haemorrhage [1,2]. It has become the leading cause of emergency hysterectomy [5]. Maternal morbidity has been reported to occur in up to 60% and mortality in up to 7% of women with placenta accreta. In addition, the incidence of perinatal complications is also increased mainly due to preterm birth [7-9].

Several risk factors for placenta accreta have been reported, including previous caesarean delivery particularly when accompanied with a coexisting placenta previa. Many studies show that placenta previa is an independent risk for placenta accreta (2-6%). All invasive procedures on the uterus or the uterine cavity have been associated with the subsequent development of placenta accreta including uterine curettage, hysteroscopic surgery, endometrial ablation, uterine artery embolization and myomectomy. However, the most important risk factor for the development of placenta accreta is a prior caesarean delivery [10,11].

The exact pathogenesis of placenta accreta is unknown. Generally, placenta accreta has been diagnosed on hysterectomy specimens when an area of accretion showed an absence of decidua, with chorionic villi in direct contact with the myometrium. This decidual maldevelopment in placenta accreta is usually associated with previous uterine surgery. The role of decidua in preventing abnormal placentation is thought to be an autocrine/paracrine feedback. Decidual natural killer (dNK) cells have an important role in the immune regulation of trophoblastic invasion; Laban et al. showed via immunohistochemistry (RLN) belongs to the insulin-like growth factor family. It plays a role as a regulator of cell growth in foetal membranes and placenta via autocrine/paracrine interactions and the decidua has been found to be its primary site of action [12, 13]. Recent studies show that most cases of placenta accreta are found in women with previous caesarean section and placenta previa, and most cases of placenta previa present in association with previous uterine surgery. This association suggests that the defective decidualisation of a prior uterine scar can have an impact on both implantation and placentation [14].

Ultrasound imaging is the mainstay of screening for placenta accreta. All women at risk of placenta accreta should be screened for signs of accretion [15]. A trans-abdominal approach with a semi-distended bladder is recommended to screen for placenta previa accreta. However, in cases of posterior placenta, due to decreased penetration and acoustic shadowing from the foetus where sonography is used as the imaging modality, MRI provides more confident diagnosis [16].

The placenta appears as a focal mass which is more hyperechoic than the underlying myometrium. The myometrium appears as a well-demarcated rim of hypoechoic tissue. By the third trimester more vascular lakes and calcifications appear within the placenta, which give the placenta a heterogeneous appearance. Placental lacunae are vascular structures of varying size and shape that are found in the placental parenchyma, and give a moth-eaten or Swiss cheese appearance to the placenta. They are indistinct parallel linear vascular channels, with turbulent flow. Placental lacunae have been the most predictive ultrasonographic finding of placenta accreta, especially with grade 2 and higher (4 lacunae and more). Yang et al. found the sensitivity of placental lacunae in the diagnosis of placenta accrete was 100%, with a specificity of 97.2%, positive predictive value (PPV) of 93.8% and negative predictive value (NPV) of 100% [16,17].

Loss of the normal retroplacental so no lucent zone has been found in association with placenta accreta. However, it should not be used alone for diagnosis because it is angle-dependent and can be absent in cases of normal anterior placenta. This was found to have a high false positive rate of up to 20%, a sensitivity of 52% and a specificity of 57 [6,18,19].

Normally the uterine serosa-bladder interface appears as a highly echogenic thin line, with no irregularity, and no disruption or bulging into the bladder. Abnormalities of this border include irregularity, thickening and disruption of the line. Bulging of the placenta into the bladder increased vascularity on colour Doppler imaging [20].

Abnormal colour Doppler imaging [20], includes:

1. A diffuse lacunar flow pattern exhibiting diffusely dilated vascular channels scattered throughout the whole placenta and the surrounding myometrial or cervical tissues. High-velocity pulsatile venous-type flow was found in the sonolucent vascular spaces.

2. A focal lacunar flow pattern showing irregular sonolucent vascular lakes with turbulent lacunar flow distributed regionally or focally within the intraparenchymal placental area.

3. Interphase hypervascularity with abnormal blood vessels linking the placenta to the bladder with high diastolic arterial blood flow.

4. Markedly dilated peripheral subplacental vascular channels with pulsatile venous-type flow over the uterine cervix.
5. Absence of subplacental vascular signals in the areas lacking the peripheral subplacental hypoechoic zone.

In this study, we evaluated the uteroplacental vascular morphological manifestations of placenta previa accreta with the use of transabdominal color Doppler ultrasound and attempted to correlate them with the clinical outcomes of this potentially life-threatening obstetric disorder.

II. Methods and Materials

A prospective study over a four-month period from August 2016–November 2016 with institutional ethical approval was conducted in Benghazi Medical Centre, Libya. Ninety-one women with placenta previa complicated pregnancies, who had doppler ultrasound at 36 weeks gestation were included in the study.

Inclusion criteria:

Cases diagnosed as placenta previa, admitted in the hospital and planned elective caesarean section.

Exclusion criteria:

- Multiple pregnancy
- Cases of preeclamptic toxemia (PET)
- Cases of gestational diabetes (GDM)
- Polyhydramnios.

The following ultrasound criteria were assessed:

Location of placenta, distance from internal os, colour Doppler, presence/absence of clear zone, presence of lacunae and disruption of serosa.

Data analysis:

Using IBM SPSS 22.0 analysis of data included the following:

- Description of demographic and personal characters
- Description and analysis of factors and test results with chi-square, t-test, ANOVA or their alternatives.

III. Results

A total of 91 cases were included in the study. No maternal mortality was reported. The mean maternal age was 34.9 years with a mean BMI of 30.46 kg/m^2. Of 91 women included in the study, 78 (86%) were parous. More than a third of cases had no history of uterine scar. Only five cases (5.5%) reported previous history of placenta accreta.

Placenta characteristics

Location of placenta:

Placenta was covering the os in 17 cases (18.7%). Among the remaining 74 cases, the placenta was anterior in 34 cases (45.9%).

Retroplacental hypervascularity (RPHV):

RPHV was found in 35 (38.5%) of cases.

Clear zone:

A clear zone was present in most cases. Clear zone thickness among those with a clear zone was not a normally distributed variable (Smirnov-Kolmogorov: $P < 0.001$). Thickness of the clear zone ranged from 0.3 to 1.7 mm with a median of 0.8 mm.

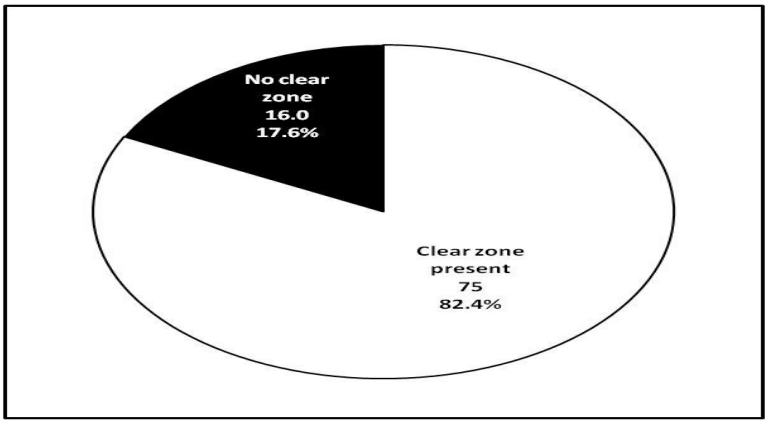


Figure 1. Cases with and without the presence of a clear zone.

Presence of lacunae:

Lacunae were visualized by ultrasound scanning in 22 cases (24.2%).

Serosal disruption:

In the majority of cases, no serosal disruption was found.

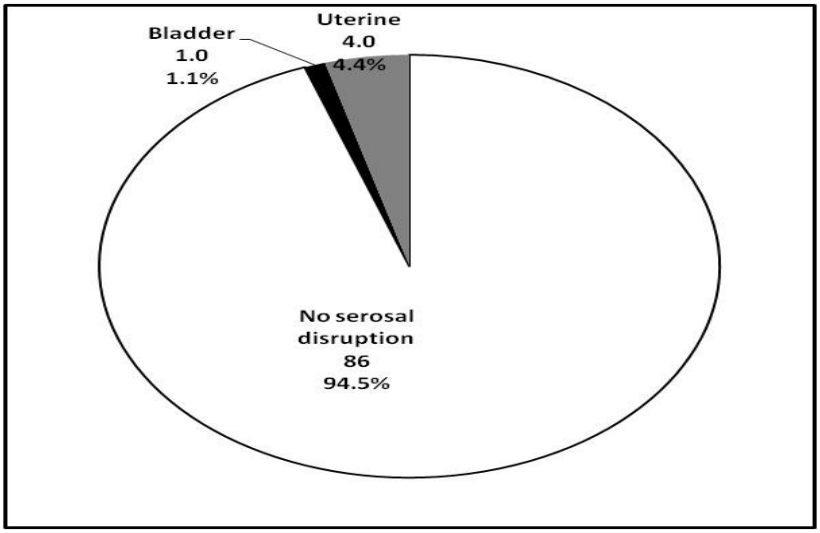


Figure 2. Percentage of cases with serosal disruption.

Placental adherence:

16.5% of cases of placenta previa had adherent placenta.

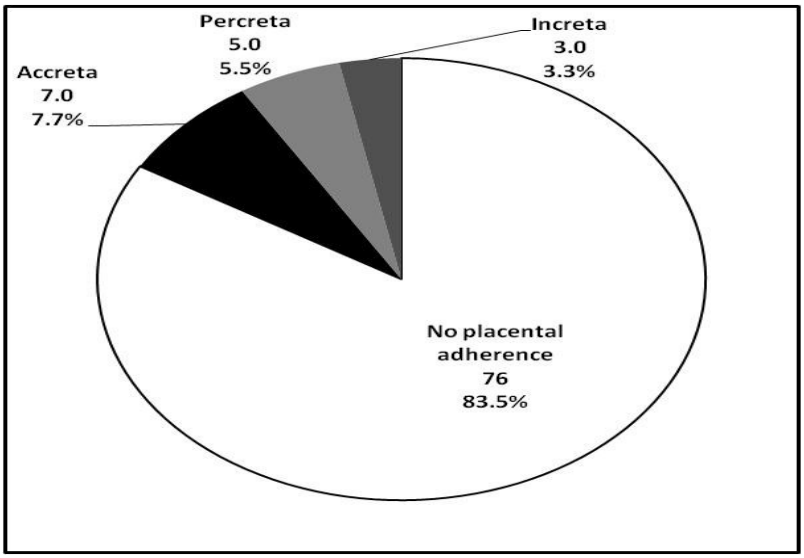


Figure 3. Placental adherence among the study population.

Prediction of adherent placenta

Previous scars and adherent placenta:

Presence of previous scars significantly increased the chance of placental adherence (Table 1). Patients with one scar had the lowest rate of placental adherence (Table 2). The medians of number of scars were significantly different across the groups of women with adherent placenta and those with non-adherent placenta.

Table 1. History of previous scars and adherent placenta.

History of previous scars	Adherent placenta		Total
	Yes	No	
Yes	13	43	56
	23.2%	76.8%	100.0%
No	2	33	35
	5.7%	94.3%	100.0%
Total	15	76	91
	16.5%	83.5%	100.0%

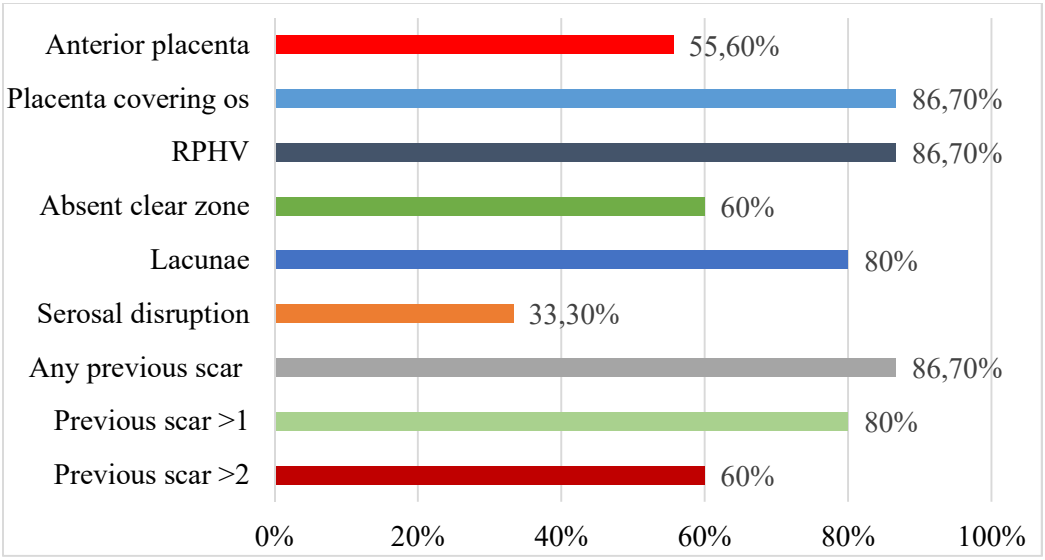
Pearson Chi-Square 4.791, $P = 0.029$

Table 2. Number of previous scars and adherent placenta

Number of Previous scars	Adherent placenta		Total
	Yes	No	
None	2	33	35
	5.7%	94.3%	100.0%
1	1	15	16
	6.2%	93.8%	100.0%
2	3	11	14
	21.4%	78.6%	100.0%
3	4	10	14
	28.6%	71.4%	100.0%
4	3	3	6
	50.0%	50.0%	100.0%
5	2	4	6
	33.3%	66.7%	100.0%
Total	15	76	91
	16.5%	83.5%	100.0%

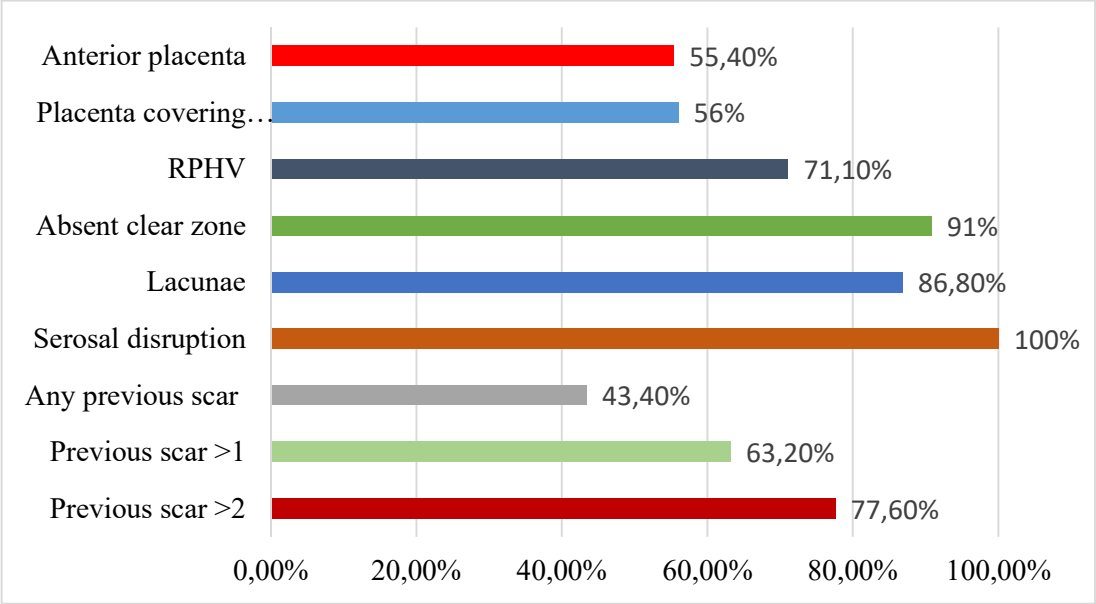
Diagnostic performance of history of scars and ultrasonic indicators:

As shown in Figure 4, a history of previous scars, the placenta covering the os, and retroplacental hypervascularity on ultrasound scanning were the most sensitive markers for adherent placenta. Serosal disruption was the most specific marker, followed by the absence of a clear zone (Figure 5). Serosal disruption also had the highest positive predictive value (Figure 6).



RPHV: Retroplacental hypervascularity

Figure 4: Sensitivity analysis of the selected markers for adherent placenta.



RPHV: Retroplacental hypervascularity

Figure 5: Specificity analysis of the selected markers for adherent placenta.

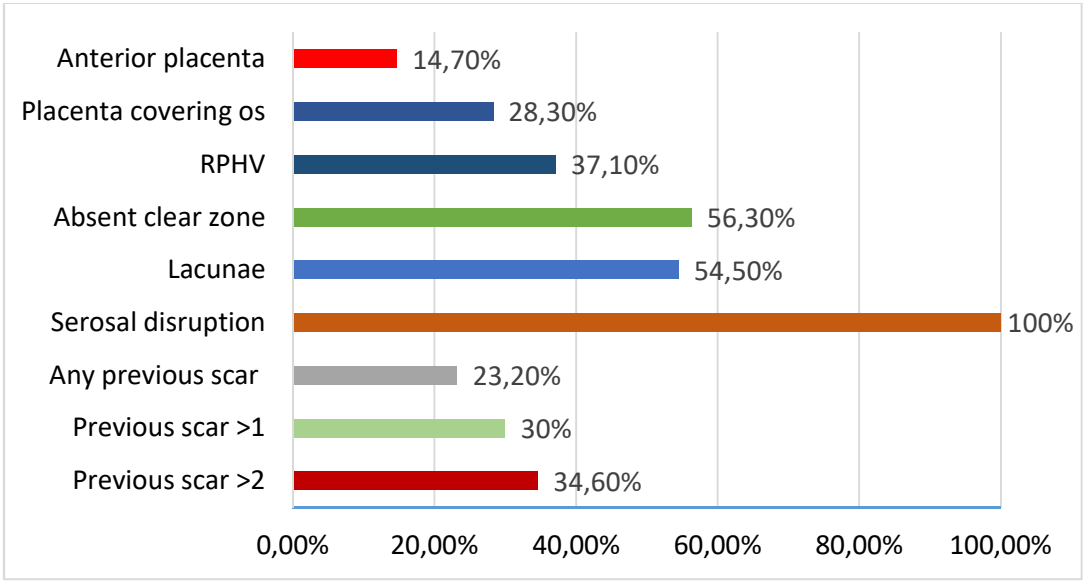


Figure 6: Positive predictive value analysis of the selected markers for adherent placenta

Retroplacental hypervascularity, presence of lacunae, and finding of placenta covering the os are the markers with highest negative predictive value (Figure 7).

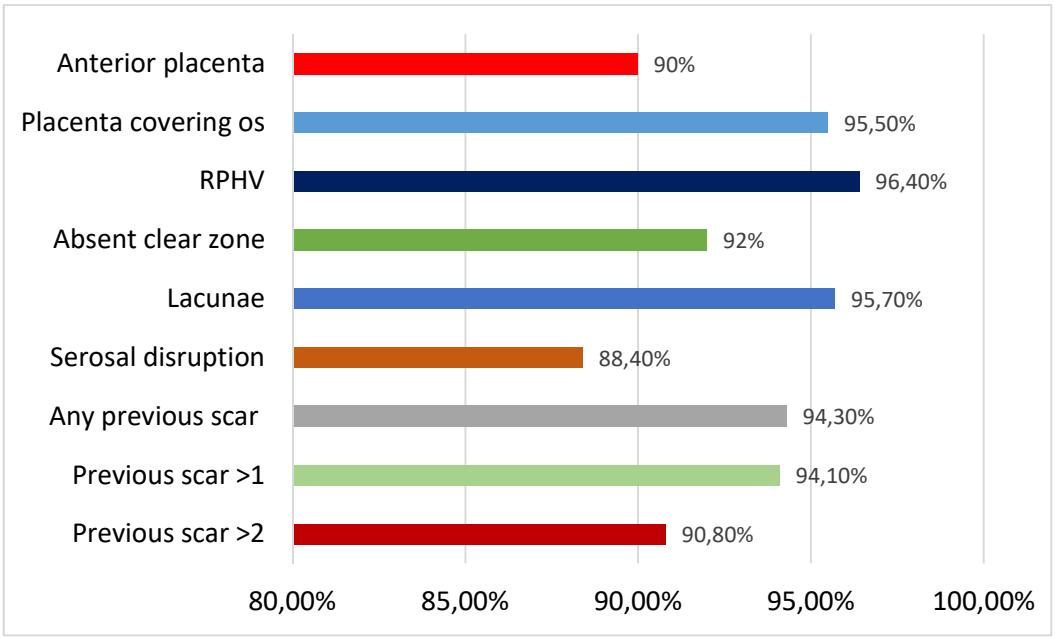


Figure 7: Negative predictive value analysis of the selected markers for adherent placenta.

The overall test performance (true results rate) was highest for serosal disruption (89.0%), then ultrasonic findings of lacunae and absence of clear zone (85.7%) (Figure 8).

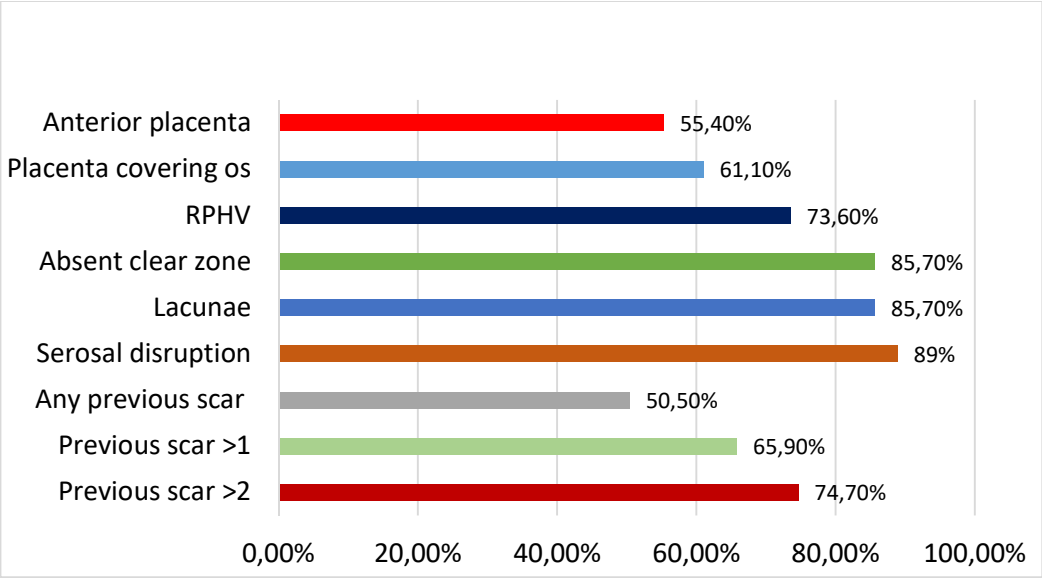


Figure 8: Test efficiency analysis of the selected markers for adherent placenta.

IV. Discussion

In the present study, 16.5% of cases of placenta previa had adherent placenta. This finding is much higher than 2 – 6% expected by Miller et al. [10] and Silver [11]. More than half of the cases (51.1%) had placenta covering the os and the placenta was reaching the os in 36.7% of cases. The placenta was within 2 cm away in 2.2% of cases and 2 – 3.5 cm away in 10% of cases. As a predictor of adherent placenta, this had a sensitivity of 86.7%, specificity of 56.0%, PPV of 28.3%, NPV of 95.5% and a total test efficiency of 61.1%. Those findings may confirm the concept that defective decidualization process is the main pathology shared between placenta previa and adherent placenta as stated by Millar et al. [14] who suggested that the presence of a prior uterine scar can have an impact on both implantation and placentation.

The mean age among the study population was 34.9 years (95% CI: 33.9 – 36.0 years; SD = 5.0 years) and ranged from 21 to 43 years. There was no significant relationship between age and adherent placenta. Most of the mothers in the study population were parous, with only 14.3% being nulliparous. These findings were in concordance with previous studies [10, 11, 21], which found that risk factors for placenta accreta include advanced maternal age, multiparity and hypertensive disorders of pregnancy.

We found that women with a history of any scar had a significantly higher risk for adherent placenta (P = 0.029) within placenta previa cases, and only 37.8% of cases had no history of uterine scar. The presence of previous scars significantly increased the chance of placental adherence (see results) and patients with one scar had the lowest rate of placental adherence. The median number of scars were significantly different across the groups of women with adherent placenta and those with non-adherent placenta. A higher number of previous scars was correlated with more adherent placenta present (P = 0.002). Previous research [11, 21] also found that the presence of previous caesarean delivery with placenta previa overlying the uterine scar will compound the risk for placenta accrete, with rates of 11% for those women with one previous caesarean section and the risk increasing to 40%, 60% and 65% for women with two, three and four or more previous caesarean deliveries, respectively.

Lacunae, which are vascular structures of varying size and shape found in the placental parenchyma giving a moth-eaten or Swiss cheese appearance to the placenta, were visualized by ultrasound scanning in 22 cases (24.2%). Diagnostically, the presence of lacunae conferred a sensitivity of 80.0%, specificity of 86.8%, PPV of 54.5 %, NPV of 95.7% and a total test efficiency of 85.7%. Previous studies [17, 16] reported 100% sensitivity, 100% NPV, 97.2% specificity and 93.8% PPV which indicate higher diagnostic utility than in the present study. Differences in the target population and operator skills may explain this difference despite the relatively high performance in the present study.

A clear zone was absent in only 17.6% of cases. The thickness of the clear zone ranged from 0.3 to 1.7 mm with a median of 0.8 mm. Absence of a retroplacental clear zone conferred a sensitivity of 60.0%, specificity of 90.8%, PPV of 56.3%, NPV of 92.0%, and total test efficiency of 85.7%.

Retroplacental hypervascularity was found in 35 cases (38.5%) of cases and conferred sensitivity of 86.7%, specificity of 71.1%, PPV of 37.1%, NPV of 96.4% and a total test efficiency of 73.6%. These test performance results are higher than those reported by Kerr [18], Berkley [6] and Comstock [19] as sensitivity in those studies was only 52% and specificity was 57%. Much higher specificity in the present study may reflect the fact that the lower segment of the uterus is less vascularized and a highly vascular retroplacental space would be unlikely as all of the investigated cases were placenta previa.

Normally the uterine serosa-bladder interface appears as a highly echogenic thin line, with no irregularity, and no disruption or bulging into the bladder [20]. In the majority of cases in this study, no serosal disruption was found. Uterine serosal disruption was found in 4.4% of cases while bladder serosal disruption was only found in 1.1% of cases. Serosal disruption conferred a sensitivity of 33.3%, specificity of 100.0%, PPV of 100.0%, NPV of 88.4% and a total test efficiency of 89.0%, which is in concordance with Comstock [19] as interruption of the bladder line has been thought to have 100% specificity. This indicator should be carefully interpreted as this line, which is an echogenic border between the bladder and myometrium, is best evaluated with putting the transducer at 90^{o} to the wall with the bladder at least partially filled.

V. Conclusion

Placenta previa confers high risk for adherent placenta with 16.5% of cases of placenta previa having adherent placenta. Previous scars were the only significant risk factors for adherent placenta in placenta previa (P = 0.029). The presence of scars confers a high sensitivity (86.7%) and high NPV (94.3%). Doppler ultrasound predicted adherent placenta with different indicators, the most sensitive being retroplacental hypervascularity and placenta covering the os (86.7%), while serosal disruption was the most specific sign (100.0%). The highest overall test performance signs were serosal disruption (89.0%), followed by presence of lacunae and absence of retro placental clear zone (both 85.7%).

Based on this study, we recommend provision of color Doppler ultrasonic scan for all mothers with previous cesarean sections or low-lying placenta by the second trimester. Further well-designed research investigating abnormal decidualisation disorders and factors related to adherent placenta is required.

References

[1] Ebrahim A, Zaiton F, Elkamash T. Clinical and ultrasound assessment in patients with placenta previa to predict the severity of intrapartum hemorrhage. The Egyptian Journal of Radiology and Nuclear Medicine. 2013; 44: 657-663.

[2] WHO, UNICEF, UNFPA and the World Bank. Trends In Maternal Mortality: 1990-2010, WHO, Geneva, 2012.

[3] Chou MM. Prenatal diagnosis and perinatal management of placenta previa accreta: past, present, and future. Taiwanese J Obstet. Gynecol. 2004; 43(2): 64-71.

[4] Wu S, Kocherginsky M, Hibbard JU. Abnormal placentation: twenty- year analysis. AJOG. 2004; 12: 07.

[5] Palova E, Redecha M, Malova A, Hammerova L, Kosibova Z. Placenta accreta as a cause of peripartum hysterectomy. Bratisl Lek Listy. 2016; 117(4): 212-6 (ISSN: 0006-9248).

[6] Berkley EM, Abuhamad AZ. Prenatal diagnosis of placenta accreta, American Institute Of Ultrasound In Medicine, J Ultrasound Med. 2013; 32:1345-1350.

[7] Hudon L, Belfort MA, Broome DR. Diagnosis and management of placenta percreta: a review. Obstet Gynecol Surv. 1998; 53: 509–17.

[8] Yap YY, Perrin LC, Pain SR, Wong SF, Chan FY. Manual removal of suspected placenta accreta at cesarean hysterectomy. Int J Gynaecol Obstet 2008; 100: 186–7.

[9] Eller AG, Porter TF, Soisson P, Silver RM. Optimal management strategies for placenta accreta. BJOG. 2009; 116(5): 648–54.

[10] Miller DA, Chollet JA, Goodwin TM. Clinical risk factors for placenta previa–placenta accreta. American Journal of Obstetrics and Gynecology. 1997; 177(1): 210-4.

[11] Silver RM, Landon MB, Rouse DJ, et al. Maternal morbidity associated with multiple repeat Cesarean deliveries. Obstet Gynecol. 2006; 107 (6): 1226-1232.

[12] Laban M, Ibrahim E, Elsafty M, Hassanin A. Placenta accreta is associated with decreased natural killer (dNK) cells population: a comparative pilot study. Eur J Obstet Gynecol Reprod Bio. 2014; 181: 284–8. [PubMed: 25195203].

[13] Bryant-Greenwood G, Yamamoto S, Lowndes K, et al. Human decidual relaxin and preterm birth. Ann N Y Acad Sci. 2005; 1041:338–44. [PubMed: 15956731].

[14] Millar L, Streiner N, Webster L, et al. Early placental insulin-like protein (INSL4 or EPIL) in placental and fetal membrane growth. Biol Reprod. 2005; 73:695–702. [PubMed: 15958731].

[15] Placenta praevia, placenta praevia accreta and vasa praevia: diagnosis and management. Green-top Guideline No. 27. January 2011.

[16] Baughman WC, Carterville JE, Shah RR. Placenta accreta: Spectrum of US and MR imaging findings. Radiographics. 2008; 28:1905-17.

[17] Yang JI, Lim YK, Kim HS, Chang KH, Lee JP, Ryu HS. Sonographic findings of placental lacunae and the prediction of adherent placenta in women with placenta previa totalis and prior Cesarean section. Ultrasound in Obstetrics & Gynecology. 2006; 28(2):178-82.

[18] Mendonca LK. Sonographic diagnosis of placenta accreta. Presentation of six cases. Journal of Ultrasound in Medicine. 1988; 7(4): 211-5.

[19] Comstock CH. Antenatal diagnosis of placenta accreta: a review. Ultrasound in Obstetrics & Gynecology. 2005; 26(1): 89-96.

[20] Warshak CR, Eskander R, Hull AD, Scioscia AL, Mattrey RF, Benirschke K, Resnik R. Accuracy of ultrasonography and magnetic resonance imaging in the diagnosis of placenta accreta. Obstet Gynecol 2006; 108: 573–581.

[21] Chattopadhyay SK, Kharif H, Sherbeeni MM. Placenta praevia and accreta after previous caesarean section. European Journal of Obstetrics & Gynaecology and Reproductive Biology. 1993; 52(3): 151-6.