ORIGINAL ARTICLE

# Uterine Artery Doppler and Morphological Features of Placenta as Predictors Of Peripartum Complications In Placenta Previa And Placenta Previa-Accreta

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Abstract

*Background*: **If a woman has a history of cesarean sections, she is more likely to experience placenta previa and placenta accreta.**

*Aim and objectives*: **To ascertain if placental morphological traits and uterine artery doppler are risk factors for mother and fetal outcomes in complex pregnancies with placenta previa or placenta previa accreta.**

*Patients and methods*: **Al-Azhar University Al Hussien Hospital's Gynecology and Obstetrics department saw 150 pregnant women between April and November 2022 for this prospective observational clinical study. The subjects were split into three categories.**

*Results*: **Among the three examined groups, there was a statistically significant distinction (p<0.05) in the left and right pulsatility index. At 1 minute and 5 minutes, there was a p<0.001, <0.001, 019, and.011 difference in the groups' GA, birth weight, and Apgar score, respectively. There was a significant difference between the groups with respect to CS hysterectomy, blood transfusion, bladder injury, premature labor, ICU, and NICU (p<0.001). That they occurred far less frequently in Group I and considerably more frequently in Group III than in Group II. No maternal mortality occurred in any of the three categories.**

*Conclusion*: **Uterine artery doppler is highly diagnostic for placenta previa and placenta previaaccreta, and predicts maternal and fetal complications, with higher lacunae, abnormal vascularity, and uterine PI significantly predicting poor maternal outcomes.**

*Keywords*: Uterine artery Doppler; Peripartum complications; placenta previa; placenta previa-accreta

## 1. Introduction

Women who have given birth via cesarean section before are more likely to develop placenta accreta when they experience placenta previa.[1] Placenta previa and accreta have been on the rise for decades, largely due to the dramatic rise in the number of caesarean sections in both industrialized and developing nations.[2]

Preterm labor increases foetal mortality and morbidity, while placenta accreta spectrum disorder (PAS) and placenta previa are major contributors to maternal morbidity and mortality due to life-threatening bleeding.[3]

To reduce maternal morbidity and mortality, it is crucial to identify placenta accreta and devise a treatment plan accordingly.[4]

There is currently no diagnostic approach that can definitively confirm the presence or absence of placenta accreta, regardless of how far imaging technology has come.[5]

Biomarkers, ultrasound, MRI, and clinical history have all played a role in the diagnosis of placenta adherence, along with patient reports of symptoms. In order to effectively plan for the reduction of maternal and foetal morbidity, antenatal diagnosis is crucial.[4] A number of ultrasonography indicators linked to placenta accreta have been documented. Grayscale and color images are used to diagnose placenta accreta. Using Doppler ultrasound.[6]

Our goal in doing this study was to identify any potential correlation between placental morphological features and uterine artery doppler in predicting maternal and fetal prognosis in cases of placenta previa or placenta previa accreta complications during pregnancy.

## 2. Patients and methods

From April to November 2022, 150 pregnant women who visited the gynecology and obstetrics department at Al-Azhar University Al Hussien Hospital were part of this prospective observational clinical study. Participants were divided into three groups:

Group I: 50 pregnant women with normal pregnancy; Group II: 50 pregnant women with placenta previa; and Group III: 50 pregnant women with placenta previa with placental morphological features of placenta accreta. The three groups were formed from the participants: Half of the pregnant women in Group I had normal pregnancies, half had placenta previa, and half had placental morphological characteristics of an accreta in Group III.

Inclusion Criteria:

Gestational age for singleton pregnancies is typically between 34 and 37 weeks, determined either by a first-trimester ultrasound or the first day of labor and delivery. Individuals who are free of any preexisting conditions and who are willing to participate in the study after providing their written consent.

Exclusion criteria:

Refusal by the patient, many pregnancies or intrauterine foetal death, additional medical issues such as hypertension during pregnancy, heart disease, rheumatological disorders, and the presence of known fetal abnormalities.

Methods

Patients were subjected to:

Complete history taking, examination:

General examination, abdominal and local clinical examination.

Abdomen palpation during pregnancy: Fundal height (level):

The fundus's height at 12 weeks, 24 weeks, and 36 weeks is determined by its position at the symphysis pupis, umbilicus, and xiphisternum levels.

Fundal grip:

Using a gentle, full-handed technique, one can identify the fetal portion at the uterine fundus, such as: Breech means broad, soft, and uneven. A head that is hard, rounded, and perfectly round.

Lateral or umbilical grip:

To locate the fetal back and limbs, place palms on both sides of the uterus at the umbilicus level. Use one hand to fix the uterus and the other to palpate the back. Auscultation:

Fetal heart sound (FHS) was detected using a fetal stethoscope or sonicaid, with the pinard heard after 20 weeks of pregnancy, to determine the fetus's back and heart rate. Assessment of the membranes:

The rupture of membranes in the cervix may be evident if liquor drains, but it's crucial to feel for intact membranes over the presenting part. If the part is well applied, wait for a contraction and occasionally feel the umbilical cord.

Determining the position of the presenting part:

Position refers to the relationship between a fixed point on the presenting part and the symphysis pubis of the mother's pelvis, determined through vaginal examination, with vertex, face, and breech presentations being the most common.

Laboratory investigation:

Laboratory tests performed on patients prior to surgery, including but not limited to: complete blood count (CBC), renal function tests, liver function tests, international normalized ratio (INR), PT, and PTT, Blood sugar levels after eating and fasting.

Ultrasonography evaluation:

The study examined women in the supine position, focusing on fetal viability, maturity, age, weight, and amniotic fluid. Ultrasound findings suggested placenta accreta, including features such as a vascular interplacental gap, a pattern of vascularity, a localized exophytic mass invading the bladder, myometrial thinning, and the absence of a retroplacental sonolucent zone. Normal, aberrant, and severe uteroplacental hypervascularity were the three categories used to describe the placenta's vascularity. A Voluson 730 Pro V color Doppler machine was used to conduct TAS and TVS. Doppler examinations of the two uterine arteries: The main uterine artery, with its characteristic high-velocity pattern, and the apparent crossing of the external iliac artery and vein can be seen when the transducer is angled medially and placed in the lower lateral quadrant of the uterus. The placental artery and the non-placental uterine artery are two branches of the same artery that run parallel to the placenta.

Color Doppler findings of placenta accreta:

Blood flow with turbulence, a diffuse lacunar pattern, hypervascularity at the interface, and significantly enlarged subplacental vascular channels on the periphery are all diagnostic criteria for placenta accreta. Based on these results, it seems that the placenta-bladder blood arteries are not functioning normally.
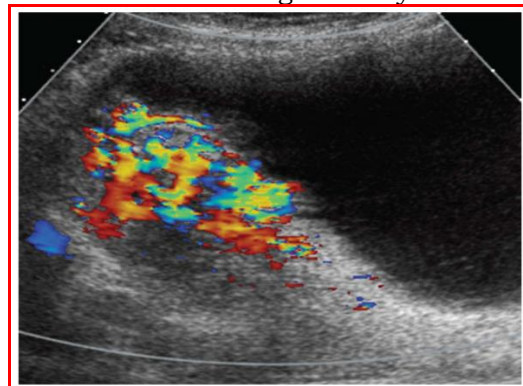


Figure 1. Turbulent flow in the lacunae and increased vascularity between the placenta and bladder in a case of placenta percreta using color
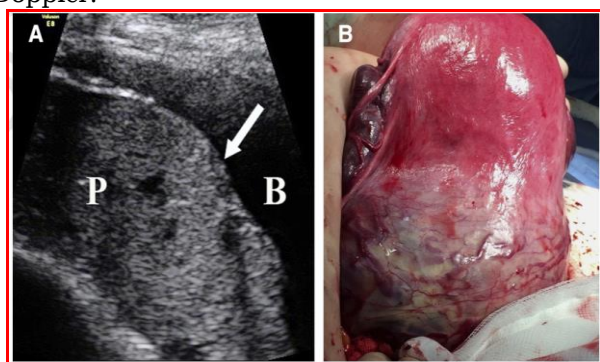
Doppler.



Figure 2. Myometrial thinning secondary to abnormally invasive placenta (P) accreta. A, Transabdominal ultrasound longitudinal view of P previa at 36 weeks showing no clear zone or myometrium detectable (arrow) between P and bladder (B). B, Findings at surgery later the same day showed neovascularization and myometrial distension over the accreta area.
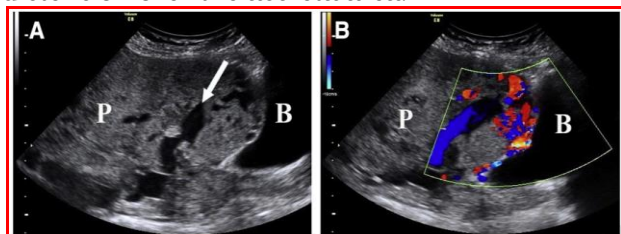


Figure 3. Transabdominal ultrasound longitudinal views of placenta (P) previa accreta at 36 weeks. A, "Motheaten" area with numerous lacunae of different sizes and shapes secondary; and B, high-velocity, turbulent blood flow within lacunae on color Doppler imaging next to the bladder (B).
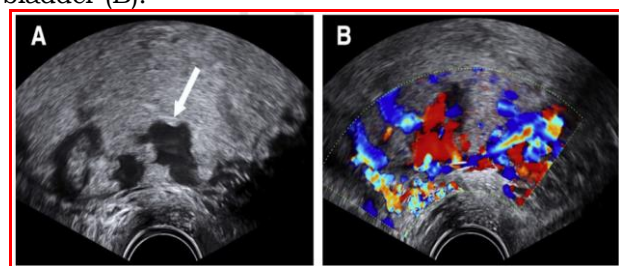


Figure 4. Transvaginal ultrasound views of placenta previa increta at 20 weeks. A, "Moth-eaten" appearance of placenta with numerous lacunae of different sizes and shapes secondary (arrow); and B, high-velocity, turbulent blood flow within lacunae on color Doppler imaging.

Outcome Measures:

Peripartum problems affecting the mother and her unborn child were the results of this research: Maternal complications: maternal demise, Blood transfusions, bladder damage, CS hysterectomy, and ICU hospitalization are examples of maternal morbidity. Neonatal complications:

Newborn mortality, low birth weight, admission to the neonatal intensive care unit, and Apgar scores at 1 and 5 minutes.

Ethical Consideration:

The Al-Azhar University Al Hussien Hospital's Institutional Review Board had received the study protocol for clearance. It was approved by the Al-Azhar Faculty of Medicine's Ethical Committee. All research participants were required to sign an informed consent form before they could take part. At every stage of the study, personal privacy and confidentiality were upheld. Every participant in the study was given information about the protocols and their right to decline participation or to leave the study at any time without providing an explanation. Participants received guarantees of anonymity and confidentiality for all information submitted.

Statistical Analysis:

Coding, data entry, and analysis of past records, basic clinical exams, lab results, and outcome measures are all done in Microsoft Excel. Next, the data was imported and analyzed using SPSS version 20.0, which stands for the Statistical Package for the Social Sciences. Quantitative data were represented by means ± standard deviation, and qualitative data by numbers and percentages; tests for significance in the differences were either Pearson's correlation or Spearman's correlation. Results were deemed significant when p-values were determined to be less than 0.05 or less than 0.001. Statistical analysis was carried out after the data had been collected. A battery of statistical tests and parameters was utilized.

## 3. Results

*Table 1. Clinical and demographic features of the groups under study.*

|  | Group I (n=50) | Group II (n=50) | Group III (n=50) | F | p |
|---|---|---|---|---|---|
| Age (years) Mean ± SD | 28.56 ± 4.73 | 29.11 ± 4.12 | 29.7 ± 4.31 | .842 | .433 |
| BMI (kg/m$^2$) Mean ± SD | 26.6 ± 2.69 | 26.29 ± 2.53 | 27.12 ± 2.84 | 1.22 | .299 |
| Parity |  |  |  |  |  |
| Primi | 36 (72%) | 33 (66%) | 32 (64%) | .788 | .674 |

Maternal age, BMI, and parity did not significantly differ across the groups (p>0.05), (Table 1).

*Table 2. Placental location distribution among the studied groups.*

|  | Group I (n=50) | Group II (n=50) | Group III (n=50) | $\chi^2$ | P |
|---|---|---|---|---|---|
| Placenta |  |  |  |  |  |
| Fundal posterior | 50 (100%) | 0 | 0 | 162 | <0.001 |
| Marginal anterior | 0 | 35 (70%) | 21 (42%) |  |  |
| Complete centralis | 0 | 15 (30%) | 29 (58%) |  |  |

A significant difference (P<0.001) was observed between the groups with respect to preterm placental site, (Table 2).

*Table 3. Indices of the uterine arteries in the three groups under study.*

|  | GROUP I (N=50) | GROUP II (N=50) | GROUP III (N=50) | F | P |
|---|---|---|---|---|---|
| **RIGHT** |  |  |  |  |  |
| RESISTANCE INDEX MEAN ± SD | .621 ± .076 | .643 ± .097 | .635 ± .151 | .490 | .614 |
| PULSATILITY INDEX MEAN ± SD | .741 ± .125 | .954 ± .203 | 1.02 ± .158 | 39 | <0.001 |
| **LEFT** |  |  |  |  |  |
| RESISTANCE INDEX MEAN ± SD | .614 ± .082 | .626 ± .137 | .648 ± .167 | .835 | .436 |
| PULSATILITY INDEX MEAN ± SD | .793 ± .142 | .922 ± .265 | 1.13 ± .201 | 33 | <0.001 |

A statistically significant variation was seen in the right and left pulsatility index (p<0.05) across the three groups under investigation, (Table 3).

*Table 4. Neonatal characteristics among the studied groups.*

|  | Group I (n=50) | Group II (n=50) | Group III (n=50) | F | p |
|---|---|---|---|---|---|
| GA (weeks) Mean ± SD | 38.63 ± 1.02 | 36.8 ± 1.62 | 37.29 ± 1.84 | 23 | <0.001 |
| Birth weight (kg) Mean ± SD | 3.29 ± 0.265 | 2.65 ± 0.483 | 2.81 ± 0.564 | 27 | <0.001 |
| Apgar at 1 min Mean ± SD | 7.32 ± 1.07 | 6.49 ± 2.26 | 6.87 ± 1.54 | 4.1 | .019 |
| Apgar at 5 min Mean ± SD | 9.7 ± 0.843 | 8.81 ± 2.31 | 9.15 ± 0.649 | 4.68 | .011 |

At one minute and five minutes, there was a significant difference between the groups in terms of GA, birth weight, and Apgar score (p<0.001, <0.001, 019, and.011, respectively), (Table 4).

*Table 5. Peripartum complications between the studied groups.*

|  | Group I (n=50) | Group II (n=50) | Group III (n=50) | $\chi^2$ | P |
|---|---|---|---|---|---|
| CS hysterectomy | 0 | 4 (8%) | 19 (38%) | 31 | <0.001 |
| Blood transfusion | 2 (4%) | 21 (42%) | 40 (80%) | 59 | <0.001 |
| Bladder injury | 0 | 2 (8%) | 12 (24%) | 20 | .001 |
| Preterm labor | 4 (8%) | 24 (48%) | 26 (52%) | 26 | <0.001 |
| ICU | 0 | 7 (14%) | 11 (22%) | 12 | .003 |
| NICU | 0 | 15 (30%) | 13 (26%) | 17 | <0.001 |

Regarding bladder injury, blood transfusion, premature labor, ICU, and NICU, there was a significant difference between the groups (p<0.001). And they occurred far less frequently in group I and somewhat more frequently in group III as opposed to group II. Furthermore, none of the three groups experienced maternal mortality, (Table 5).

*Table 6. Correlation between vascularity pattern and peripartum complications between the studied groups.*

|  | Vascularity pattern | | | P |
|---|---|---|---|---|
|  | Normal (n=85) | Mild (n=10) | Moderate (n=55) |  |
| CS hysterectomy | 3 (3.5%) | 2 (20%) | 18 (32.7%) | <0.001 |
| Blood transfusion | 18 (21.2%) | 5 (50%) | 40 (72.7%) | <0.001 |
| Bladder injury | 0 | 1 (10%) | 13 (23.6%) | <0.001 |

| Preterm labor | 7 (8.2%) | 4 (40%) | 43 (78.2%) | <0.001 |
|---|---|---|---|---|
| ICU | 1 (1.2%) | 2 (20%) | 15 (27.3%) | <0.001 |
| NICU | 3 (3.5%) | 3 (30%) | 22 (40%) | <0.001 |

The vascularity subgroups differ significantly in terms of bladder injury, blood transfusion, premature labor, ICU, and NICU, as well as CS hysterectomy. that the moderate vascularity grouping had a considerably higher frequency of them than the mild and normal subgroups (p<0.001), (Table 6).

*Table 7. Multivariate regression analysis to determine the possible predictors of maternal outcome.*

|  | B | 95% CI | P |
|---|---|---|---|
| AGE | .593 | -1.917 – 3.104 | .622 |
| BMI | -12.807 | -26.24 – 0.628 | .060 |
| PARITY | -27.64 | -90.42 – 35.14 | .363 |
| HIGHER LACUNAE | -.193 | -0.824 – 0.439 | .025 |
| RETROPL. SONOLUTENT ZONE LOSS | -10.033 | -80.58 – 60.52 | .166 |
| ABNORMAL VASCULARITY | 17.952 | -66.05 – 101.9 | .036 |
| UTERINE ARTERY RI | -.189 | -0.820 – 0.442 | .533 |
| UTERINE ARTERY PI | 1.939 | -0.861 – 4.740 | .016 |

Higher lacunae, abnormal vascularity, and uterine PI were significant predictors for poor maternal outcome, (Table 7).

## 4. Discussion

A significant and perhaps fatal intrapartum and postpartum hemorrhage may be linked to placenta accreta, a severe pregnancy complication. It now accounts for between 40 and 60 percent of emergency hysterectomy cases, making it the primary cause of these instances.[7, 8]

There were not any statistically significant variations between the three groups based on maternal age, BMI, and parity, according to the current study. Because P is more than 0.05.

Our findings are in line with HESHAM et al., who aimed to study the way placenta previa and placenta accreta affect the Doppler velocimetric changes in the uterine arteries. Fifteen patients with anterior placenta previa and fifteen patients with anterior placenta previa accreta made up Group A and Group B, respectively, of thirty pregnant women in this comparative prospective clinical investigation. Researchers found no statistically significant difference in maternal age or parity across the groups. (Signature significance level more than 0.05).[9]

According to the results of our study, there was a highly statistically significant difference between the groups when it came to the distribution of preterm placental sites, such as the placenta fundal posterior, placenta marginal anterior, and placenta complete centralis. (P <0.001)

The findings we obtained align with those of Zakria et al. They set out to determine if uterine artery Doppler and distinct placental

morphological characteristics may predict mother and baby outcomes in difficult pregnancies with placenta previa and placenta accreta. It is an observational research that is prospective on 30.[10]

Thirty patients with normal pregnancies were compared to individuals with placenta previa, including placenta previa accreta. Three groups were allocated to the cases: Group I: thirty women in a typical pregnancy. Group II: fifteen pregnant women with placenta previa. Group III: fifteen expectant mothers with placenta previa who also had placental accreta morphological characteristics. They discovered that there was a highly statistically significant variation in the distribution of placental locations between the groups with relation to preterm placental sites, such as the placenta fundal posterior, placenta marginal anterior, and placenta complete centralis. (P<0.001)

Our research revealed that there was a highly significant statistical difference in the right and left pulsatility index between the three groups under investigation with reference to uterine artery indices. (P<0.001). However, there was no statistically significant difference in the right and left resistance scores across the three groups.

The findings we obtained align with those of Eliwa et al. They discovered that there was a highly statistically significant difference in the right and left pulsatility index between the three groups under study, in relation to uterine artery indices. (P<0.0001). According to their research, patients with placenta accreta have lower mean PI values than patients without accreta as determined by uterine artery Doppler velocimetry.[11]

In our investigation, we discovered that there were statistically significant differences in the groups' newborn parameters, including GA, birth weight, and Apgar scores at 1 and 5 minutes.

The findings we obtained align with Maged et al., who stated that there was a statistically significant difference in the groups' Apgar scores at one minute and five minutes with relation to neonatal features.[12]

We observed statistically significant differences between the groups with respect to CS hysterectomy, blood transfusion, bladder damage, premature labor, intensive care unit, and neonatal intensive care unit peripartum problems. They were far less common in Group I and much more common in Group III than in Group II. In addition, none of the three groups had any maternal mortality.

The findings we obtained align with Eliwa et al., who discovered that when it came to peripartum complications, the groups differed significantly in terms of CS hysterectomy, blood transfusion, maternal death, bladder injury, and intensive care unit (ICU) visits. That they occurred far less frequently in Group A and much more frequently in the Accreta group than in the previa Group.[11]

Our research showed that the Lacunae subgroups differed significantly with respect to CS hysterectomy, blood transfusion, bladder injury, premature labor, intensive care unit, and neonatal intensive care unit (NICU) admissions. That they were far more common in groupings 4 and 3 than in the other subgroups.

The findings we obtained align with Eliwa et al., who discovered that the Lacunae groupings differed significantly with respect to CS hysterectomy, blood transfusion, newborn mortality, bladder damage, premature labor, intensive care unit, and neonatal intensive care unit outcomes. That subgroups 4 and 3 have them at much higher rates than the other subgroups.[11]

We discovered that when it came to CS hysterectomy, blood transfusion, bladder damage, preterm labor, intensive care unit, and neonatal intensive care unit (NICU) care, there was a highly significant difference in the vascularity subgroups. The intermediate vascularity subgroup had them at significantly higher rates than the mild and normal groupings.

The findings we obtained align with Eliwa et al. According to the paper, there is a highly significant link between the subgroups of placental vascularity and the following maternal peripartum complications: CS hysterectomy, blood transfusion, bladder injury, premature labor, intensive care unit, and neonatal intensive care unit (p-value < 0.001).[11]

Multivariate regression analysis to determine the possible predictors of maternal outcome. We found that higher lacunae, abnormal vascularity, and uterine PI were significant predictors for poor maternal outcome.

### 4. Conclusion

Uterine artery doppler is highly diagnostic for placenta previa and placenta previaaccreta, and predicts maternal and fetal complications, with higher lacunae, abnormal vascularity, and uterine PI significantly predicting poor maternal outcomes.

## Disclosure

The authors have no financial interest to declare in relation to the content of this article.

## Authorship

All authors have a substantial contribution to the article

## Funding

## Conflicts of interest

There are no conflicts of interest.

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