The Value of Placental Vascularization Indices and Placental Volume in Pregnancies with Antiphospholipid Syndrome for Prediction of Neonatal Outcome

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Abstract

The purpose of this study was designed to explore the value of placental volume and placental vascularization indices in prediction of neonatal outcome in pregnant women with antiphospholipid syndrome. **Patient and Methods:** Seventy (70) pregnant women were categorized into 2 groups; **Group A**: control group (35 cases); **Group B**: antiphospholipid group (35 cases). The perinatal outcomes were correlated to the results of placental volume and placental vascularization indices. The accuracy of placental volume and placental vascularization indices in the prediction of adverse outcome were calculated. **Results:** placental vascularization indices, VI, FI and VFI were lower in group B in 1st and 2nd US scans with statistically significant P values (<0.05). Also placental volume was lower in antiphospholipid group in 1st and 2nd US scans with statistically significant P values (<0.001). There was a significant correlation between the two groups concerning the gestational age at termination of pregnancy, Apgar score and birth weight (with P-value < 0.05). Moreover, IUGR in group B was significantly correlated to placental volume and placental vascularization indices. **Conclusion:** From our study we could conclude that placental volume and placental vascularization indices are good utilities for the assessment of fetal wellbeing and prediction of neonatal outcome in pregnant women with antiphospholipid syndrome.

Keywords: placental volume, placental vascularization indices, antiphospholipid syndrome, VI, FI, VFI, neonatal outcome, IUGR.

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Introduction

Antiphospholipid antibodies are autoantibodies directed against phospholipid- binding proteins. Among these groups of antibodies, lupus anticoagulant (LA) and anticardiolipin antibodies (aCL). Antiphospholipid syndrome (APS) comprises the identification of antiphospholipid antibodies in the setting of arterial and venous thrombus and /or pregnancy loss. APS can be primary when no evidence of autoimmune disease is found, or secondary to autoimmune processes like systemic lupus erythematous (SLE) in a 40% of the cases **(1).**

Impaired placental perfusion, which is associated with development of PE/IUGR, could be reflected in an increased uterine artery pulsatility index (PI). Measurement of the uterine artery PI is influenced by sonographer experience and by gestational age, maternal weight, racial origin and preexisting diabetes mellitus **(2).**

Few studies have investigated the importance of this technique in the assessment of fetal growth restriction (FGR). These studies reported decreased placental vascular indices in growth- restricted fetuses. Similarly, other additional studies assessed the placentae of growth- restricted fetuses using the virtual organ computed- aided analysis (VOCAL) rotational technique, which allows the measurement of vascular indices across the entire placental volume. The evaluation of placentas revealed that FGR is correlated with decreases in placental volume and vascular indices **(3).**

No previous studies examined placental vascularization indices and placental volume in pregnancies with antiphospholipid syndrome.

The current study was designed to assess placental vascularization indices and placental volume in pregnancies with antiphospholipid syndrome and their values for prediction of neonatal outcome.

Patients and Methods

The present study was carried out in Obstetrics and Gynecology Hospital and High Risk Unit, Cairo University (Kasr El-Ainy) and Al-Galaa Teaching Hospital, during the period of 14 months, from January 2018 to end of February 2019.

Pregnant women eligible for the study had the following inclusion criteria: Singleton pregnancy, Gestational age of ≥34 weeks. Pregnant women with antiphospholipid syndrome (1ry or 2ry APS) either alone or/and with hypertension or/and intrauterine growth restriction (IUGR) for group B.

To diagnose APLS, at least one laboratory and one clinical criterion should be met.

Laboratory criteria: Detection of Lupus Anticoagulant in plasma two or more occasions twelve or more weeks apart. Detection of IgG or IgM subtype of anticardiolipin antibodies in serum or plasma measured by standard ELISA, two or more occasions twelve or more weeks apart. Detection of Anti- b2 glycoprotein- I antibody of IgG and/or IgM isotype in serum or plasma measured by standard ELISA, two or more occasions twelve or more weeks apart.

Pregnant women who had any of the following conditions were excluded from the study: Twin or multiple pregnancies, congenital fetal anomalies, gestational age of less than 34, pregnant females with other medical disorders (Diabetes Mellitus , history of having Cardiac or Renal disease), women with placental or umbilical artery anomalies, antepartum hemorrhage (placental abruption, placenta previa and vasa previa), posterior placenta, history of rupture of membrane and patient refusal or falled outs.

Seventy (70) pregnant women, where 35 of them were free from any medical disorder by history and clinical examination were considered as control **(Group A)** and 35 cases had antiphospholipid syndrome fulfilling the inclusion and exclusion criteria **(Group B)**.

Patients included in the study were subjected to the following:

A written informed consent was obtained from the pregnant women who are included in the study.

Full History Taking Including: Age, gestational age, confirmed by the 1st day of her LMP or ultrasound examination during the 1st trimester, gravidity and Parity and body Mass Index (BMI) = weight/ (height in meters)^2.

Through Clinical Examination: General examination; included vital signs and full obstetric examination.

Ultrasound: Interval ultrasonographic biometry [biparietal diameter (BPD), head circumference (HC), femur length (FL), abdominal circumference (AC), and estimated fetal weight (EFW)], fetal lie, presentation, placental site, assessment of amniotic fluid and exclusion of fetal anomalies. Doppler velocimetry of the umbilical artery (UA) and middle cerebral artery (MCA) were performed. Placental volume was done for all cases using VOCAL technique. Power Doppler was activated to automatically calculate the vascular indices, vascularization index (VI), flow index (FI) and vascularization flow index (VFI). All the above ultrasonographic parameters were done twice, the 1st time at 34-37 weeks of gestation, and the 2nd one just before termination of pregnancy.

Doppler Study: The machine used was GE voluson E10, EC330 (4D ultrasound machine), General Electric (GE) company, GE Healthcare, Austria, Jan 2018**.** Doppler velocimetry of the umbilical artery (UA) and middle cerebral artery (MCA) were performed using a color Doppler system with curvilinear transabdominal probe.

Neonatal assessment: Adverse (or abnormal) perinatal outcome will be defined as any perinatal complications such as: Perinatal death, Low birth weight< 10th percentile. **Watkins et al., (4)** were defined low birth weight as less than 2,500 g (up to and including 2,499 g), Cesarean section for fetal distress, Meconium staining of the amniotic fluid, 5-minute Apgar score <7 and Stay in the neonatal intensive care unit for >24 hours.

The perinatal outcomes were being correlated to the results of placental vascularization indices, placental volume, umbilical artery (UA) and middle cerebral artery (MCA) Doppler Indices, and cerebro-placental ratio (CPR). The accuracy of placental vascularization indices, placental volume, UA and MCA Doppler Indices, and CPR in the prediction of adverse outcome were calculated.

Statistical Methods: Data were coded and entered using the statistical package for social sciences SPSS version 25. Data was summarized using mean and standard deviation for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparisons between groups were done using unpaired t test. For comparison of serial measurements (1st and 2nd US) within each patient paired t test was used **(5)**. For comparing categorical data, Chi square (χ2) test was performed. Exact test was used instead when the expected frequency is less than 5 **(6)**. ROC curve was constructed with area under curve analysis performed to detect best cutoff value of Doppler indices for detection of bad outcome **(7)**. P-values less than 0.05 were considered as statistically significant.

Results

The present study included 70 pregnant women who fulfilling the inclusion criteria mentioned before, where 35 of them were free from any medical disorder by history and clinical examination were considered as control **(Group A)** and 35 cases had antiphospholipid syndrome **(Group B)**; they were admitted to Kasr Alainy Obstetrics and Gynecology Hospital, Cairo university (in high risk department) and Al-Galaa Teaching Hospital during the period from January 2018 to the end of February 2019.

Among 35 pregnant women who had APS; 10 of them had hypertension (28%), 8 had IUGR (23%) and 2 cases (6%) had both (hypertension and IUGR), on the other hand, these 35 patients with APS; 20 of them had 1ry APS (57%) and 15 had 2ry with SLE (43%) as shown in **Fig. 1.**

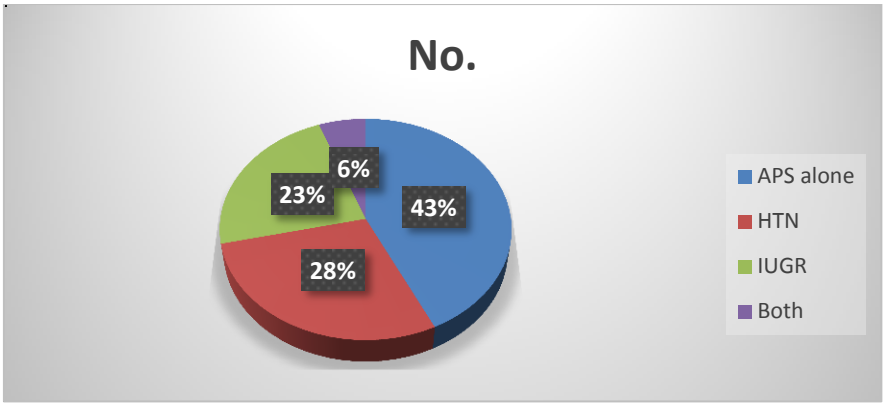

Figure (1): Number of cases among APS group

The collected demographic data from both groups regarding age, BMI and parity are presented in the following tables **(Table 1)** with values are given as mean ± SD or number (percentage).

Table (1): Comparison between both groups as regard age and BMI

	control group (group A)		antiphospholipid group (group B)		P value
	Mean	SD	Mean	SD	
Age	27.46	5.47	28.46	4.90	0.423
BMI	31.70	4.98	32.47	4.84	0.512

Estimated fetal weight (EFW) in the **1st** scan showed no significant difference between both groups (P-value 0.867). However, in the **2nd** scan, EFW was lower in group B with statistically significant (P values <0.001) **(Table 2)**.

Table (2): Comparison between both groups as regard EFW in the first and second US scans

	control group (group A)		antiphospholipid group (group B)		P value
	Mean	SD	Mean	SD	
EFW (1st US) gm	2452.86	331.83	2438.23	392.85	0.867
EFW (2nd US) gm	3063.26	280.30	2700.94	453.02	*< 0.001

* P-values less than 0.05 were considered as statistically significant.

As regards amniotic fluid index (AFI), the ultrasound study in the **1st** examination of **(Group A)** revealed that 33 patients (94.3%) were with normal amount of liquor, 1 showed oligohydramnios (2.9%) and 1 showed polyhydramnios (2.9%). While in **(Group B)** in the **1st** ultrasonographic examination, 24 patients (68.6%) were with normal amount of liquor and 11 showed oligohydramnios (31.4%). **Table (3)**

Table (3): Comparison between both groups as regard AFI in the first and second US scans

		control group (group A)		antiphospholipid group (group B)		P value
		Count	%	Count	%	
AFI (1st US)	**Normal**	33	94.3%	24	68.6%	*0.003
	Oligo	1	2.9%	11	31.4%	
	Poly	1	2.9%	0	.0%	
AFI (2nd US)	**Normal**	26	74.3%	12	37.5%	*0.002
	Oligo	8	22.9%	20	62.5%	
	Poly	1	2.9%	0	.0%	

* P-values less than 0.05 were considered as statistically significant.

In the **1st** ultrasonographic examination of control group **(Group A)**, the Doppler study showed that UA-PI ranged between 0.5 and 1.4 with mean ± SD (0.89 ± 0.2). UA-RI ranged between 0.4 and 0.79 with mean ± SD (0.57 ± 0.09). MCA-PI ranged between 1.4 and 3.2 with mean ± SD (1.92 ± 0.42). MCA-RI ranged between 0.7 and 1.1with mean ± SD (0.83 ± 0.1). CPR ranged between 1.01 and 2.25 with mean ± SD (1.48 ± 0.28) **(Table 4)**. While on examining APS group **(Group B)** in the 1st scan, UA-PI ranged between 0.54 and 1.4 with mean ± SD (0.85 ± 0.21). UA-RI ranged between 0.4 and 0.75 with mean ± SD (0.56 ± 0.1). MCA-PI ranged between 1.19 and 3.5 with mean ± SD (1.73 ± 0.58). MCA-RI ranged between 0.66 and 1.1with mean ± SD (0.77 ± 0.17). CPR ranged between 0.9 and 2.2 with mean ± SD (1.46 ± 0.35) **(Table 4)**. Abnormal Ductus Venosus Doppler was found in one case. In the **2nd** ultrasonographic examination of control group **(Group A)**, the Doppler study showed that UA-PI ranged between 0.5 and 1.1 with mean ± SD (0.81 ± 0.14). UA-RI ranged between 0.4 and 0.7 with mean ± SD (0.52 ± 0.06). MCA-PI ranged between 1.1 and 2.8 with mean ± SD (1.61 ± 0.31). While on examining APS group **(Group B)** in the 2nd scan, UA-PI ranged between 0.6 and 1.24 with mean ± SD (0.87 ± 0.19). MCA-RI ranged between 0.64 and 1.1with mean ± SD (0.76 ± 0.07). CPR ranged between 1 and 2 with mean ± SD (1.4 ± 0.29) **(Table 4)**.

Table (4): Comparison between both groups as Doppler indices in the second US scan

	control group (group A)		antiphospholipid group (group B)		P value
	Mean	**SD**	**Mean**	**SD**	
UA-PI (2nd US)	0.81	0.14	0.87	0.19	0.144
UA-RI (2nd US)	0.52	0.06	0.56	0.09	0.058
MCA-PI (2nd US)	1.61	0.31	1.60	0.43	0.912
MCA-RI (2nd US)	0.76	0.09	0.76	0.07	0.968
CPR (2nd US)	1.49	0.22	1.40	0.29	0.175

Table (5): Comparison between both groups as placental vascular indices in the first US scan and second scan

	control group (group A)		antiphospholipid group (group B)		P value
	Mean	**SD**	**Mean**	**SD**	
first US scan					
VI (Placental V.I.) (1st US)	37.24	11.33	11.13	4.78	*< 0.001
FI (Placental V.I.) (1st US)	33.47	4.62	30.34	3.53	*0.002
VFI (Placental V.I.) (1st US)	12.45	4.69	5.38	2.77	*< 0.001
second scan					
VI (Placental VI.) (2nd US)	37.60	11.64	10.14	3.82	*< 0.001
FI (Placental VI.) (2nd US)	33.21	5.17	24.48	3.88	*< 0.001
VFI (Placental VI.) (2nd US)	12.71	4.84	4.43	2.70	*< 0.001

* P-values less than 0.05 were considered as statistically significant.

In the **1st** ultrasonographic examination of control **(Group A)**, 3D power Doppler study of the placenta revealed that VI ranged between 15.787 and 62.237 with mean ± SD (37.24 ± 11.33). FI ranged between 24.285 and 48.42 with mean ± SD (33.47 ± 4.62). VFI ranged between 5.852 and 23.051 with mean ± SD (12.45 ± 4.69). While in APS group **(Group B)**, VI ranged between 3.896 and 23.668 with mean ± SD (11.13 ± 4.78). FI ranged between 27.561 and 46.638 with mean ± SD (30.34 ± 3.53). VFI ranged between 1.567 and 12.971 with mean ± SD (5.38 ± 2.77). **(Table 5)**. In the **2nd** ultrasonographic examination of **(Group A)**, 3D power Doppler study concluded VI ranged between 22.362 and 68.701 with mean ± SD (37.6 ± 11.64). **(Table 5)**.

Regarding vascularization indices, VI was lower in group B (APS group) in 1st and 2nd US scans with statistically significant P values (<0.001, <0.001 respectively). FI was lower in group B in 1st and 2nd US scans with statistically significant P values (0.002, <0.001 respectively). **(Fig. 2, 3)**.

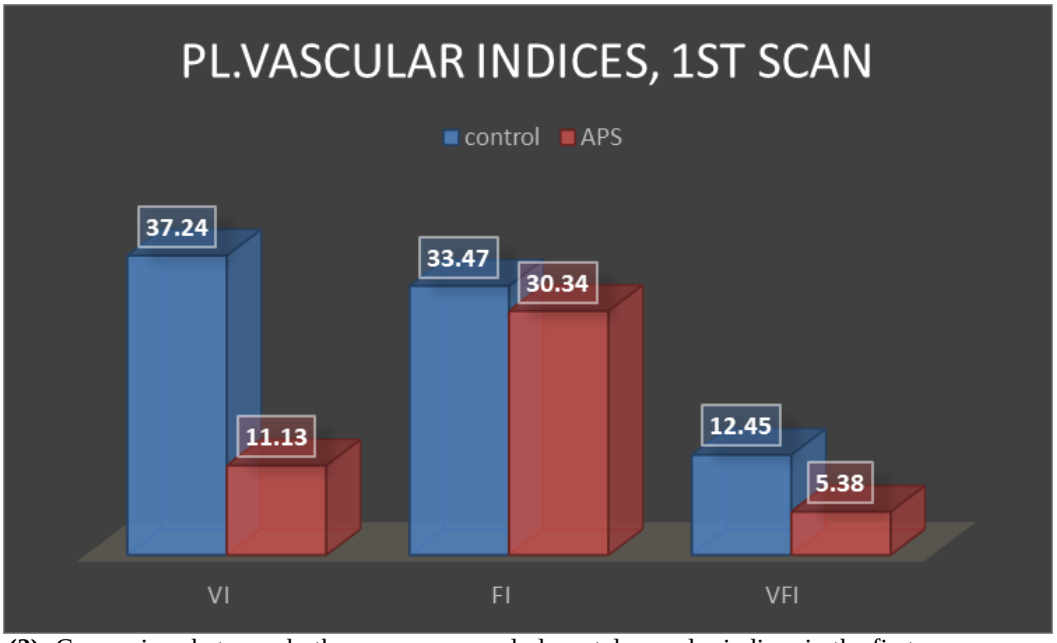

Figure (2): Comparison between both groups as regard placental vascular indices in the first scan.

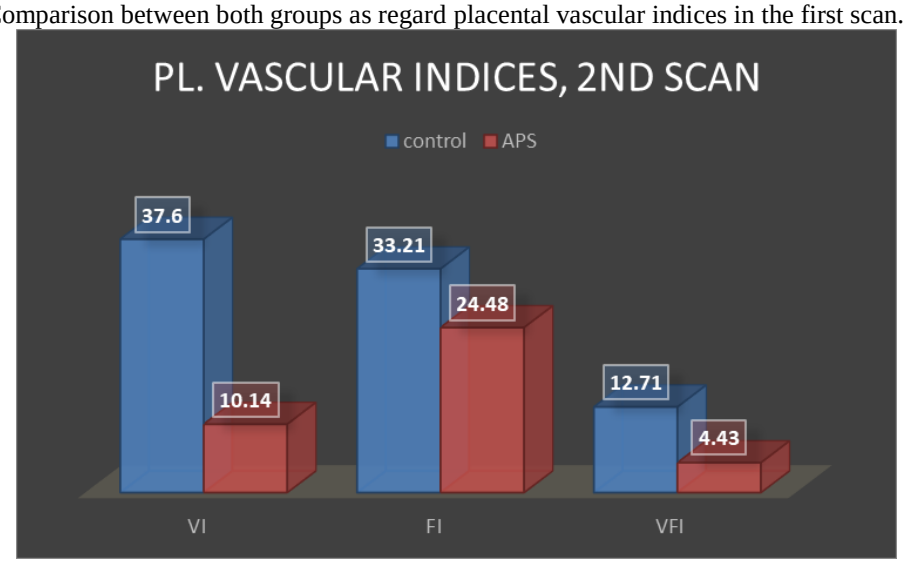

Figure (3): Comparison between both groups as regard placental vascular indices in the second scan.

Table (8) showed comparison between both groups as regards placental volume in the 1st and 2nd US scans. In the **1st** ultrasonographic examination of control group **(Group A)**, placental volume ranged between 177.77 and 834.4 cm^3 with mean ± SD (441.35 ± 174.97). And In the **2nd** scan, placental volume ranged between 197.07 and 874.12 cm^3 with mean ± SD (512.52 ± 188.44). While in the **1st** ultrasonographic examination of APS group **(Group B)**, placental volume ranged between 181.72 and 495.19 cm^3 with mean ± SD (303.52 ± 85.13). And In the **2nd** scan, placental volume ranged between 208.83 and 603.08 cm^3 with mean ± SD (362.66 ± 129.69) **(Table 6)**.

Table (6): Comparison between both groups as regard placental volume in the first and second US scans

	control group (group A)		**antiphospholipid group (group B)**		**P value**
	Mean	**SD**	**Mean**	**SD**	
PL. volume, cm^3 (1st US)	441.35	174.97	303.52	85.13	*< 0.001
PL. volume, cm^3 (2nd US)	512.52	188.44	362.66	129.69	*< 0.001

* P-values less than 0.05 were considered as statistically significant.

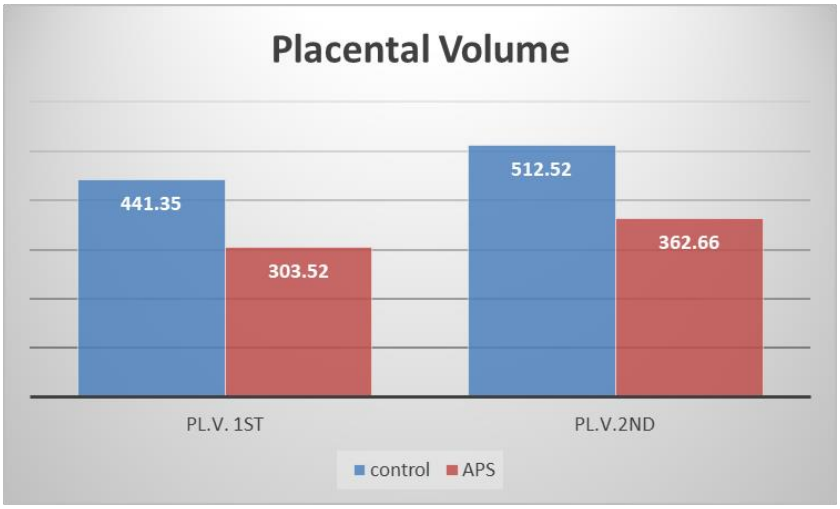

Figure (4): Comparison between both groups as regard placental volume in the first and second US scans.

Table (7) showed comparison between both groups as regards GA at termination of pregnancy and neonatal outcome with values are given as mean ± SD or number (percentage).The gestational age of at termination of pregnancy in control **(group A),** ranged between 36+4 and 40+4 weeks with mean ± SD (38.6 ± 0.95). Apgar score after 5 min ranged between 6/10 and 10/10 with mean ± SD (8.46 ± 0.78). Neonates weight in this group ranged between 2500 and 3800 g with mean ± SD (3177.14 ± 305.43). Stay in the NICU for >24 hours was observed in 1 neonate only (2.9%). While in APS group **(group B),** the gestational age of at termination of pregnancy ranged between 36 and 38+3 weeks with mean ± SD (37.03 ± 0.57). Apgar score after 5 min ranged between 6/10 and 9/10 with mean ± SD (7.6 ± 0.82).

Table (7): Comparison between both groups as regard GA at termination of pregnancy, Apgar score and birth weight and NICU admission

		control group (group A)		antiphospholipid group (group B)		P value
		Mean	SD	Mean	SD	
Apgar (Neonate)		8.46	0.78	7.60	0.81	*< 0.001
Birth weight (Neonate) gm		3177.14	305.43	2780.00	505.44	*< 0.001
GA at termination (Neonate)		38.60	0.95	37.03	0.57	*<0.001
NICU admission (Neonate)	**Yes**	1	2.9%	3	8.6%	0.614
	No	34	97.1%	32	91.4%	

* P-values less than 0.05 were considered as statistically significant.

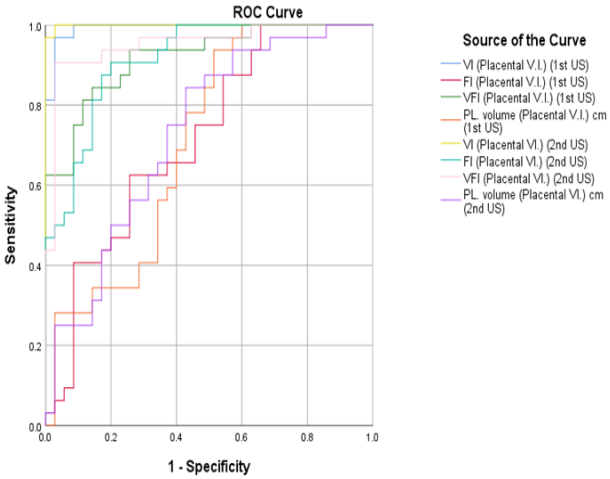

Figure (5): ROC curve of values of placental volume and placental vascular indices between control and study group

Figure (5) shows the Roc curve of the values of placental volume and placental vascular indices obtained in the control and antiphospholipid group which revealed that VI, FI, VFI and placental volume showed higher area under the curve in the antiphospholipid group than control group denoting lower placental vascularity and lower placental volume in the antiphospholipid pregnant women and so, had less amount of blood flow towards their fetuses that can lead to lesser expected fetal weight in their fetuses.

Table (8) shows that in the mothers with low birth weight neonates in both groups, mean VI were 9.04 (± 4.93 SD) and 6.2 (± 2.88 SD) in 1st and 2nd US scans respectively. FI mean values were 27.9 (± 2.78 SD) and 22.48 (± 2.67 SD) in 1st and 2nd US scans respectively. VFI mean values were 2.58 (± 1.03 SD) and 2.42 (± 1.08 SD) in 1st and 2nd US scans respectively.

Table (8): Comparison of placental volume and placental vascular indices in the mothers with low birth weight neonates and mothers with normal birth weight neonates

	Expected fetal weight				P value
	Low Birth Weight		Normal		
	Mean	SD	Mean	SD	
VI (Placental V.I.) (1st US)	9.04	4.93	11.96	4.56	0.104
FI (Placental V.I.) (1st US)	27.90	2.78	31.31	3.36	*0.008
VFI (Placental V.I.) (1st US)	2.58	1.03	6.50	2.42	*< 0.001
PL. volume, cm^3 (1st US)	281.83	106.32	312.20	75.84	0.348
VI (Placental VI.) (2nd US)	6.20	2.88	11.94	2.68	*< 0.001
FI (Placental VI.) (2nd US)	22.48	2.67	25.38	4.06	*0.049
VFI (Placental VI.) (2nd US)	2.42	1.08	5.35	2.74	*0.003
PL. volume, cm^3 (2nd US)	236.49	92.72	420.01	100.59	*< 0.001

* P-values less than 0.05 were considered as statistically significant.

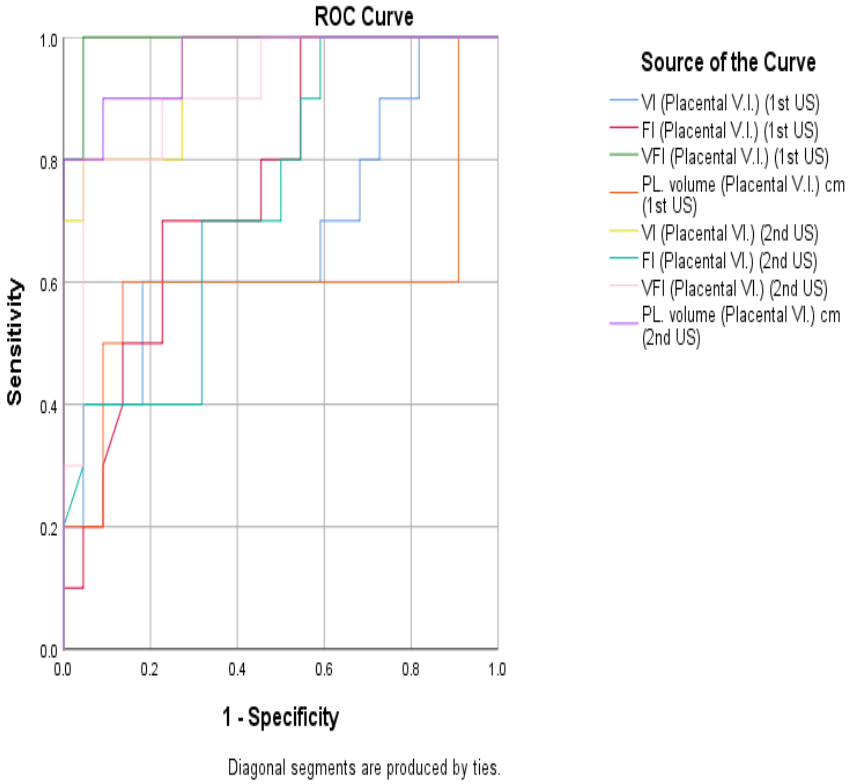

Figure (6): ROC curve for specificity and sensitivity of placental vascular indices and placental volume for prediction of IUGR.

Figure (6) shows the Roc curve for specificity and sensitivity of the values of placental volume and placental vascular indices obtained in the antiphospholipid group for prediction of IUGR which revealed that FI and VFI in fetuses with IUGR had a much lower values than fetuses with no IUGR in the first US scan with a statistically significant P value (0.019 and < 0.001 respectively).

In the pregnant women with 1ry APS, mean VI were 13.08 (± 4.94 SD) and 10.42 (± 4.39 SD) in 1st and 2nd US scans respectively. However, in the 2ry APS, mean VI were 8.52 (± 3.11 SD) and 9.69 (± 2.74 SD) in 1st and 2nd US scans respectively **(Table 9)**.

Table (9): Comparison between pregnant ladies with 1ry and 2ry antiphospholipid as regard placental volume and placental vascular indices

	Pregnant ladies with antiphospholipid				**P value**
	1ry		**2ry (+SLE)**		
	Mean	**SD**	**Mean**	**SD**	
VI (Placental V.I.) (1st US)	13.08	4.94	8.52	3.11	*0.004
FI (Placental V.I.) (1st US)	30.07	3.46	30.69	3.71	0.612
VFI (Placental V.I.) (1st US)	5.26	3.05	5.55	2.43	0.763
PL. volume, cm^3 (1st US)	307.66	90.38	298.01	80.34	0.745
VI (Placental VI.) (2nd US)	10.42	4.39	9.69	2.74	0.607
FI (Placental VI.) (2nd US)	23.51	3.72	26.09	3.76	0.068
VFI (Placental VI.) (2nd US)	5.04	3.08	3.42	1.54	0.101
PL. volume, cm^3 (2nd US)	395.28	129.39	308.30	115.43	0.065

* P-values less than 0.05 were considered as statistically significant.

Discussion

The present study was designed to assess of placental vascularization indices and placental volume in pregnancies with antiphospholipid syndrome and their values for prediction of neonatal outcome.

Our study was a de-novo study because no previous studies examined placental vascularization indices and placental volume in pregnancies with antiphospholipid syndrome.

However, few studies had investigated the importance of this technique in the assessment of fetal growth restriction (FGR). These studies reported decreased placental vascular indices in IUGR. Similarly, other additional studies assessed the placentae of hypertensive pregnant women and growth- restricted fetuses using VOCAL rotational technique, which allowed the measurement of vascular indices across the entire placental volume. The evaluation of entire placentae revealed that FGR and preeclampsia were correlated with decrease in placental volume and vascular indices.

The accuracy of placental volume and vascular indices in the prediction of adverse outcome were calculated, as primary outcome variable. Also, our study aimed to assess UA and MCA Doppler indices in pregnant ladies with APS as secondary outcome variable.

The current study included 70 women, and was categorized in 2 groups, control group and antiphospholipid group.

As regarding the results of our study, placental vascularization indices and placental volume were lower in antiphospholipid group in 1st and 2nd US scans with statistically significant values than that of control group. Our results agreed with study done on 40 patients with preeclampsia, 3D PD-US vascularity index was significantly correlated with gestational age, although each of the indices showed different behavior. FI index increases linearly and progressive throughout pregnancy, VI index increased until week 30th, then hang on the value of the plateau until week 37th and then decreased. FI, VI and VFI of the placenta were significantly lower in the severe preeclampsia compared with normal pregnancy **(8).**

Also, Odibo et al. in 2012, evaluated 388 women, PE was seen in 30 (7.7%), GH in 37 (9.0%) and SGA in 31 (8.0%). In that study, they found that the mean vascular indices of first-trimester placentas were lower in pregnancies that subsequently developed PE compared with unaffected pregnancies. In addition, those pregnancies with both PE and SGA had a significantly lower FI compared with normal controls. In addition, they showed that the mean first-trimester placental volumes in these pregnancies that developed PE were not significantly different compared to unaffected gestations **(9).**

In the present study, low birth weight was significantly correlated to placental vascularization indices in the 1st and the 2nd scan. However it

showed no significant correlation with VI in the 1st scan. Placental volume was significantly lower in the pregnant women who had born a neonate with low birth weight in the 2nd US scan, which agreed with a study in 2015, evaluated 126 normotensive and 128 hypertensive pregnant women in a prospective case–control study from March 2011 to March 2013. They found that, neonates who were diagnosed with SGA had poor placental vascularization and higher umbilical artery S/D **(10).**

Also, in the current study, IUGR in APS group was significantly correlated to placental indices in the 1st and the 2nd scan. However it showed no significant correlation with VI in the 1st scan. Placental volume was significantly lower in the pregnant women who had born a neonate with IUGR in the 2nd US scan. However it showed no significant correlation with placental volume in the 1st scan.

Current study results regarding IUGR was agreed with a prospective case-control study done on 254 women concluded that placental vascularization was reduced in pregnancies complicated by IUGR. Median VI was 3.7% (interquartile range [IQR] 3.2%-4.2%) in the IUGR group and 10.1% (IQR 8.6%-10.9%) in the control group (p = 0.001). Median FI value was 40.0 (IQR 39.7-42.5) in the IUGR group and 45.1 (IQR 44.1-53.1) in the control group (p = 0.012). Median VFI was 2.2 (IQR 2.1-2.4) in the IUGR group and 4.8 (IQR 4.4-5.3) in the control **(11).**

Also, **Abule´ et al., (3)** found that in severe growth-restricted fetuses, all placental vascular indices (VI, FI and VFI) were significantly reduced when compared to the nomogram.

In the present study, hypertension in APS group was significantly correlated to placental volume in the 2nd scan which showed higher mean placental volume value in pregnant women with antiphospholipid with hypertension than in pregnant ladies with antiphospholipid with no hypertension.

Yuan et al., (10) evaluated 126 normotensive and 128 hypertensive pregnant women in a prospective case–control study from March 2011 to March 2013. He found that, compared with normotensive pregnancies, there was less intraplacental vascularization in hypertensive pregnant women, and intraplacental vascularization was the worst in women with severe preeclampsia. Intraplacental vascularization in gestational hypertension and non-severe preeclampsia did not differ from that in the normotensive group **(10).**

Another study evaluated 66 healthy pregnant women and 62 pregnant women with hypertensive disorders and concluded that pregnancies complicated by hypertensive disorders have reduced placental vascularization but not reduced placental volumes. More pronounced reduced placental vascularization appears to be related to the severity of the hypertensive disorder **(12).**

Conclusion

Placental volume and vascularization indices were decreased in antiphospholipid pregnant women with statistically significant values. Also, placental volume and vascularization indices can predict IUGR and low birth weight in antiphospholipid group.

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