

**Correlation between umbilical arterial doppler parameters and oligo-hydromnios in uncomplicated third trimester pregnancy.**

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**Abstract**

**Background:** Doppler study of the placental vessels has an important role in detection of impaired placental development and its complications. Amniotic fluid volume is an important parameter of placental function. Changes in umbilical artery doppler parameters in cases with decreasing amount of fluid volume in third pregnancy without cause may be due to placental malfunction.

**Objective:** To evaluate the umbilical doppler parameters including Pulsatility Index (PI), Resistive Index (RI) and Systolic to Diastolic ratio (S/D) in full term pregnancies with normal amniotic fluid volume (amniotic fluid index of 8-25 cm), borderline amniotic fluid volume (5.1-8 cm) and those with oligohydramnios ( amniotic fluid volume less than 5 cm) to exclude placental malfunction in those with lower than normal fluid volume.

**Patients & Methods:** One hundred seventeen full terms pregnant were evaluated between February 2014 and June 2016, at Azadi teaching hospital /Kirkuk city and outpatient clinic. Three groups were identified according to their amniotic fluid volume: decreased, borderline and normal amniotic fluid volume, the groups were labeled as (group A, B and C) respectively. Umbilical arterial doppler parameters (including RI, PI and S/D) were measured in all patients and the results were compared among the three groups.

**Results:** There was no statistically significant difference ( $P=0.29$ ) in the mean RI values among the groups, as the mean RI value was 0.61 for group A, 0.59 for group B and 0.59 for group C. The mean PI values of the three groups were not significantly different ( $P=0.75$ ), neither the mean S/D values ( $P=0.77$ ); mean PI value was 1.01 for group A, 0.98 for group B, and 0.97 for group C; S/D values were as the following 2.59 for group A, 2.51 for group B and 2.55 for group C. The same analysis was done in subgroups divided according to the maternal age, the older age group 34-40 years revealed significantly ( $P=0.049$ ) higher mean S/D value in group C (0.50) compared to both group B (0.39) and group A (0.26); and significantly ( $P=0.05$ ) higher mean RI value for group C (0.64) compared to group B (0.60) possibly due the smaller gestation age in group C.

**Conclusion:** There is no correlation between umbilical artery velocity waveform parameters and amniotic fluid volume in uncomplicated third trimester pregnancy, so routine use of doppler in such cases is not recommended as there was no underlying placental dysfunction.

**Key wards:** Pulsatility index (PI), resistive index (RI), Systolic diastolic (S/D), amniotic fluid volume. 3

## Introduction

The umbilical artery (UA) was the first vessel to be examined by doppler ultrasound and has become the most popular investigated vessel in pregnancy (1, 2). Umbilical artery flow parameters reflect placental vascular resistance which decreases with advancing gestation (3,4).

The UA blood flow was analyzed and reported in terms of Doppler indices, of the many indices, the systolic/ diastolic ratio (S/D ratio), the pulsatility index (PI) and the resistance index (RI) were most frequently used in obstetrical examinations (2).

Studies have declared that AFI (Amniotic Fluid Index) is an accurate indicator for estimation of proper placental function and has a major role in screening for impaired placentation and its bad effects (4); studies had concluded that assessment of the UA Doppler parameters, in comparison to the nonstress test, results in better fetal outcome (5). AFI is one of the most important criterions for assessment of fetal biophysical profile which can predict pregnancy outcome (6). Normal amniotic fluid dynamics are important, as insufficient or excessive amounts of amniotic

fluid are associated with adverse fetal outcome, even in the absence of fetal malformations (7); it assesses the health of mother and the fetus and is changed in many physiological and abnormal conditions (4), and its assessment by ultrasound is one of the important methods in the evaluation of fetal health in all risk categories (7,8). There is wide variation in normal ranges for mean AFI values according to population, race, and geography(6). The amniotic fluid is important for proper fetal development and growth. Normal amniotic fluid volume differs according to gestational age, its volume increases with advancing gestational age, reaching the peak at 800-1000 ml, which coincides with 36-37 weeks' gestation (9,10).

There are different ways to measure the amount of amniotic fluid, including clinical palpation, measurement of single deepest vertical pocket (11,12), and (AFI) as described by Phelan et al. in 1987, which is the most commonly used and reliable way for calculating the amniotic fluid volume till today (13,14,15), uterus is divided into four quadrants using linea nigra as a vertical line and a transverse line passing through

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umbilicus, the sum of maximum amniotic pocket assessed in the quadrants is calculated and represents the AFI<sup>(13)</sup>.

Oligohydramnios (reduced amniotic fluid volume for a given gestational age), is an early sign of placental insufficiency and is associated with decreased fetal weight<sup>(4, 6)</sup>. Other abnormal ultrasound findings, such as increased bowel echogenicity, mild cardiomegaly as well as abnormal uteroplacental doppler, aid in the diagnosis of placental insufficiency as the cause of the reduced amniotic fluid volume<sup>(4)</sup>.

The incidence of oligohydramnios is 4.5%, and

severe oligohydramnios is a complication in 0.7% of all pregnancies<sup>(16)</sup>; the severity is proportional to growth restriction, and is frequently reflects the extent of placental insufficiency<sup>(9)</sup>. This study was done to assess the relationship between the doppler umbilical artery flow velocity waveform parameters (PI, RI and S/D) and fluid volume among full term pregnant women in different maternal age 4 groups to reveal underlying placental dysfunction among those with borderline amniotic fluid volume and those with oligohydramnios.

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### Material and methods

study). Both primigravida and multigravida were included.

The amniotic fluid volume was assessed by AFI that was regarded as the best method<sup>(17)</sup>, done by dividing the uterus in to four quadrants using maternal sagittal midline vertically and an arbitrary transverse line midway between pubis and upper edge of the uterine, the amount of fluid in each quadrant was calculated and the sum was derived and represent the AFI. Oligohydramnios was defined as AFI of less than 5 cm<sup>(18)</sup>, and labeled as group A;

One hundred seventeen patients 15-40 years old women with their gestational age between 34 and 40 weeks were evaluated between February 2014 and June 2016, using color Doppler duplex ultrasound system using 3.5 MHZ convex transducer ( Fukoda Denshi machine; Tokyo , Japan), at Azadi teaching hospital and outpatient clinic in Kirkuk city . All had singleton pregnancy (cases of premature rupture of membrane, congenital fetal anomalies and maternal medical diseases were excluded from the

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of S/D ratio, RI and PI were recorded by each gestation; the mean of the results were compared among the groups.

The data were analyzed for means and 95 % confidence interval of each waveform index using SPSS computer program version 20. Statistical differences between groups were determined using analysis of variance (ANOVA). A level of 0.05 was required for significance.

borderline amniotic fluid volume defined as AFI in the range of 5.1-8 cm (19, 20), labeled as group B; and normal amniotic fluid volume was when AFI was 8-24 cm (17, 21) and labeled as group C. Umbilical arterial doppler indices (including RI, PI and S/D) measured during fetal apnea by one examiner at the free loop site where the best waveform signal could be seen. Of three measurements, the mean average.

### RESULTS

One hundred seventeen, 18-42 years old pregnant women were examined, their gestational age were 34-40 weeks, 45 of them were nulliparous and 72 were multiparous (table 1). 32.6% were

with oligohydramnios (group A), 34.2% had borderline AFI (group B), and 34.2% of the cases had normal AFI (group C). (Fig 1.A, B and C).

Table 1. Descriptive data of the study population.

Characteristic	Group A	Group B	Group C
Maternal age(year)	29.0	29.5	28.2
Nulliparity	16	14	15
Gestational age (weeks)	37.4	36.8	36.85

Doppler umbilical artery flow velocity waveform was measured for each case, the mean value of RI, mean PI and mean S/D for each group were calculated (Fig 1.D, E and F) and compared among them and presented in the Table 2.

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**Table 2. Umbilical artery doppler measurements according to amniotic fluid volume.**

Amniotic fluid volume	RI	PI	S/D
Group A	0.61	1.01	2.59
Group B	0.59	0.98	2.51
Group C	0.59	0.97	2.55
<i>PV</i>	0.29	0.75	0.77

There was no significant difference in the umbilical artery mean RI ( $PV=0.29$ ), mean PI ( $PV=0.75$ ), neither in mean S/D ( $PV=0.77$ ) among the groups. Each group was subdivided according to the maternal age in to 15-23 years, 24-32 years, and 33-40 years age groups and the data were analyzed accordingly.

There was no significant difference in the umbilical artery mean RI, mean PI neither in S/D among the three groups in 15-23 years age ( $PV=0.34, 0.48, \text{ and } 0.37$  respectively) , and 24-32 years age ( $PV=0.44, 0.45, \text{ and } 0.37$  respectively) as seen in table 3 and table 4 .

**Table 3. Umbilical artery doppler measurements according to amniotic fluid volume in 15-23 years age group.**

Amniotic fluid volume	RI	PI	S/D
Group A	0.61	1.01	2.64
Group B	0.57	0.99	2.41
Group C	0.57	0.90	2.36
<i>PV</i>	0.34	0.48	0.37

While in 33-40 years old pregnant women, there was significantly higher S/D in group C compared to group A and group B; and higher RI value in group C compared to group B.

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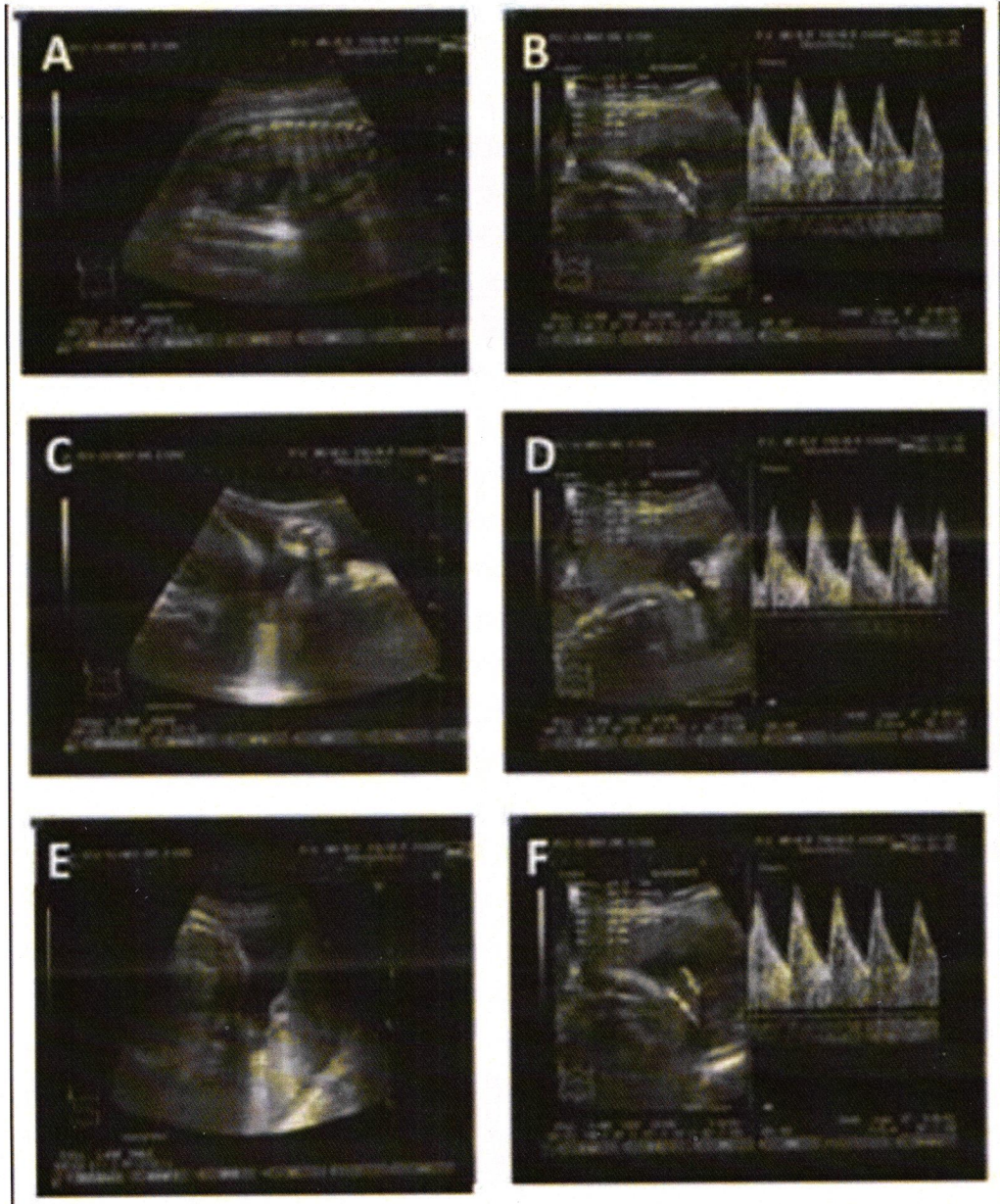
**Table 4. Umbilical artery doppler measurements according to amniotic fluid volume in 24-32 years age.**

<b>Amniotic fluid volume</b>	<b>RI</b>	<b>PI</b>	<b>S/D</b>
Group A	0.60	1.02	2.61
Group B	0.57	0.94	2.48
Group C	0.57	0.93	2.42
<i>PV</i>	0.44	0.45	0.54

**Table 5. Umbilical artery doppler measurements according to amniotic fluid volume in 33-40 years age group.**

<b>Amniotic fluid volume</b>	<b>RI</b>	<b>PI</b>	<b>S/D</b>
Group A	0.62	1.01	0.26
Group B	0.60	1.01	0.39
Group C	0.64	1.08	0.50
<i>PV</i>	0.05	0.26	0.04

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**Fig1. Ultrasound appearance of pregnancies with different amniotic fluid volume and their doppler studies (A) Oligohydramnios at 35 weeks' gestation, the AFI is 2 cm. (B) The umbilical Doppler waveform in case of oligohydramnios, RI=0.56, PI=8.7, S/D=2.29. (C) Borderline amniotic fluid volume at 37 weeks' gestation, AFI=6 cm. (D) The umbilical Doppler waveform in case of borderline amniotic fluid volume, RI=0.55, PI=0.82, S/D=2.23. (E) Normal amniotic fluid volume at 38 weeks' gestation, the AFI is 10 cm. (F) The umbilical Doppler waveform in normal fluid volume, RI=0.56, PI=0.92, S/D=2.27.**

### **Discussion**

In this study, those with normal fluid volume, their mean RI was (0.59) which was comparable to a Nigerian study (0.54)<sup>(22)</sup>; Mean PI was (0.97), which was almost equal to a European study (0.98)<sup>(23)</sup>, and was less than in comparison to a study done in Bangladesh which (1.18)<sup>(24)</sup> probably due to racial differences; Mean S/D 8 in our study ratio was(2.55) which was comparable to (2.51), the result of a study done in Thailand<sup>(2)</sup>.

In our study, there was no significant difference in the umbilical artery parameters including RI, PI and S/D among the pregnant groups with different amounts of amniotic fluid, this result was same as a study done by Alok S. et al.<sup>(25)</sup>, as there was no significant association between oligohydramnios and Doppler status, and similar to another study done by Gaikwad R. et al when there was no significant difference in UA doppler velocity between those with oligohydromnios and borderline amniotic fluid volume groups.<sup>(26)</sup>

In contrast to our result for absence of a significant difference in umbilical S/D value, there was a study conducted by caroll et al. that revealed a significant

difference in S/D value in 30 cases out of 76, those who had abnormal S/D value also had adverse perinatal outcome<sup>(27)</sup>. This controversy may be due to the small sample size of both studies, thus larger sample sizes studies are recommended. Goffinet et al suggested that routine use of the Doppler umbilical artery examination had no statistically significant effect on perinatal outcome in low risk pregnancies<sup>(28)</sup> and its application has been shown to be of no proven benefit<sup>(29)</sup>.

The significant difference in the RI and S/D values in older maternal age group 34-40 years old, in which the pregnant women within group C had higher values in S/D than in group A and B; and higher RI value compared to group B in contrast to most of the studies that revealed that the pregnant with normal amniotic fluid volume had lower values<sup>(30, 28)</sup>. This probably due to their smaller mean gestational age (35 w) compared to the borderline and decreased amniotic fluid volume cases (38w and 37 w) as Pharuhas et al were concluded that S/D ratio, PI and RI decline gradually as gestation progresses, because of progressive increase in end-

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diastolic velocity with gestational age<sup>(2)</sup>.

**Conclusion:** since there was no change in umbilical artery velocity waveform parameters with decreasing amniotic fluid volume in third trimester pregnancy without bad obstetrical history, there is no need for routine doppler study in such

cases as there as there was no underlying placental dysfunction.

**Recommendations:** Larger population sample studies are recommended to reveal if there is underlying placental dysfunction in cases with decreased amniotic fluid volume of unknown cause in third trimester and its effect on the obstetrical management in such cases.

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