

Value of Fetal Renal Artery Doppler Indices in Idiopathic Oligohydramnios and Polyhydramnios

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Abstract

Background: The advent of fetal hemodynamic studies performed in conjunction with Doppler velocimetry of the umbilical arteries enabled clinicians to detect abnormal fetal blood flow and evaluate perfusion of the fetal organs. Technological advances have permitted the study of other vessels, including the renal artery, thereby improving fetal surveillance. The aim of this work is to study the relation of renal artery flow velocity waveforms and amniotic fluid volume in normal pregnancies and those complicated by either polyhydramnios or oligohydramnios. **Methods:** this study included 60 women; they were divided into 3 groups; *Group (I)*: included 20 women with normal amniotic fluid volume, *Group (II)*: 20 women with oligohydramnios, *Group (III)*: 20 women with polyhydramnios. Pulsed wave Doppler sonographic studies was performed on the participants placed in the left lateral position with a 3.5-MHz convex transducer. The wall filter was set at the lowest available setting (50–

75 Hz) to preserve the end-diastolic component of the waveform. **Results and Conclusion:** There is a relation between renal artery flow velocity waveforms and Amniotic fluid index, whether normal, oligohydramnios or polyhydramnios, using Pulsed wave Doppler Ultrasonography. An increase in Renal Artery PI value develops in relation to decreased AFI (Oligohydramnios) especially in the third trimester, which may be an indicator for rapid delivery to save the life of the fetus. Oligohydramnios could be predicted according to changes in the Renal artery PI values. In pregnancies with increased AFI (Polyhydramnios), Renal artery PI values were decreased

Keywords: Fetal; Renal Artery; Doppler; Oligohydramnios; Polyhydramnios

Introduction

In the second and third trimesters of pregnancy, amniotic fluid volume is an indicator of fetal well-being and is an important measurement during antenatal fetal testing. Amniotic fluid volumes have been described as oligohydramnios if the actual volume of the amniotic fluid is less than 500 mL or as Polyhydramnios if the volume is more than 2000 mL (1).

However, the definition of normal amniotic fluid has previously been made according to each gestational age. Rossi and Prefumo published some normative data for amniotic fluid index throughout pregnancy and noted that the mean amniotic fluid index changed weekly (2).

Oligohydramnios or polyhydramnios are characteristic features of structural and functional anomalies and signal to the health-care provider that additional assessments or antenatal testing is required (3).

Oligohydramnios has been associated with abnormalities, such as meconium staining, congenital anomalies, growth retardation, dysmaturity and fetal asphyxia (4). Polyhydramnios has been associated with

fetal structural abnormalities, aneuploidy and macrosomia (5).

There are many causes of polyhydramnios, such as diabetes mellitus, isoimmunization, fetal infections and placental abnormalities, but the majorities (50–60%) of polyhydramnios cases appear to be idiopathic (3).

An increased or decreased amniotic fluid volume is also thought to be a factor in the increased incidence of complications during labor, an approximately two-fold increased risk of operative delivery and cesarean section for non-reassuring fetal heart rate patterns and adverse perinatal outcome (6).

Using ultrasound imaging, the fetal renal circulation can be assessed to determine the relation of renal artery flow velocity waveforms and amniotic fluid volume in normal pregnancies and those complicated by either polyhydramnios or oligohydramnios (1).

The advent of fetal hemodynamic studies performed in conjunction with Doppler velocimetry of the umbilical arteries enabled clinicians to detect abnormal fetal blood flow and evaluate perfusion of the fetal organs. Technological advances have

permitted the study of other vessels, including the renal artery, thereby improving fetal surveillance (7).

The aim of this work was to study the relation of renal artery flow velocity waveforms and amniotic fluid volume in normal pregnancies and those complicated by either polyhydramnios or oligohydramnios.

Patients and methods

This cross-sectional observational study, was conducted during the period from October 2019 to January 2021, all patients were enrolled from Benha University Hospital, El-Galaa Teaching Hospital and other private centers.

- **Inclusion criteria:**

- 1- Age : Any age
- 2- Single viable intrauterine pregnancy.
- 3- Gestational age 28-40 weeks

- **Exclusion criteria:**

- 1- Patients with any additional co-morbidities.
- 2- Known fetal congenital malformations.

- 3- Pregnant women who will be diagnosed with major fetal anomalies especially fetal renal anomalies.

Women was divided into three groups:

1. *Group (I):* 20 women with normal amniotic fluid volume.
 2. *Group (II):* 20 women with oligohydramnios.
 3. *Group (III):* 20 women with polyhydramnios.
- All patients were matched by maternal age, gestational age, and parity at the time of sonography with control patients who are healthy and normotensive.

The protocol of this study was approved by the research ethical committee of Benha Faculty of Medicine , Benha University . A written Informed consent from the patients about the study according to the policy of Benha University hospital that necessitate no harmful procedure was performed to any patient.

All patients were subjected to thorough clinical evaluation including full medical and surgical history, general clinical examination and laboratory investigations and GE Voluson E6 Ultrasound, 3.5-MHz convex transducer.

- After fulfillment of the above criteria and prerequisites, all the eligible patients were divided into three groups.
- Renal artery Doppler values was evaluated at third trimester gestation. Pulsatility index (PI) and resistive index (RI) were recorded and the amniotic fluid volume was evaluated in four quadrants.
- Fetal biometric measurements was obtained and placental structure. After detailed ultrasonography of the fetus, eligible pregnant women were included in the study.
- Pulsed wave Doppler sonographic studies was performed on the participants placed in the left lateral position with a 3.5-MHz convex transducer. The wall filter was set at the lowest available setting (50–75 Hz) to preserve the end-diastolic component of the waveform.
- The angle between the ultrasound beam and the direction of blood flow was maintained below 30°. All recordings were obtained in the absence of fetal breathing and fetal movements.
- For evaluating renal artery blood flow, an axial image of the fetal abdomen

was obtained at the level of the fetal kidneys. Using color flow Doppler, the renal arteries were evaluated at the level of their origin from the abdominal aorta. The Doppler gate then was placed within the lumen in a straight segment of the vessel.

- Amniotic fluid volume of less than 2 cm in a single quadrant by vertical measurement or less than 5 cm total in four quadrants was considered to be oligohydramnios and amniotic fluid volume of more than 25 cm total in four quadrants is considered to be polyhydramnios (1).

Statistics

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. The following tests were done: A one-way analysis of variance (ANOVA) when comparing between more than two means. Kruskal Wallis H test: for multiple-group comparisons in non-parametric data. Chi-square (X^2) test of significance was used to compare proportions between two qualitative parameters. The confidence

interval was set to 95% and the margin of error accepted was set to 5%. So, P-value <0.05 was considered significant.

Results

Age of the patients ranged from 20 -40 years with mean value of 28.16 and a median value of 29.5. Age of the fetus ranged from 28 -38 weeks with the mean value of 31.2 and a median value of 33. There was no statistically significant difference between studied groups according to maternal age (Table 1).

There was no statistically significant difference between studied groups regarding to parity, (Table 2).

There was statistically significant difference between studied groups regarding to renal artery Doppler indices PI. On the other

hand, there was insignificant difference between studied groups regarding to renal artery Doppler indices RI (fig. 1).

Case No. 1: A 28 year old pregnant lady, examined at 35 weeks of gestation with adequate amount of amniotic fluid, AFI was 12, fetal renal artery (RI) was 0.98, and fetal renal artery (PI) was 2.70 (fig. 2).

Case No. 2: A 35 year old pregnant lady, examined at 31 weeks of gestation with decreased amount of amniotic fluid, AFI was 3, fetal renal artery (RI) was 0.98, and fetal renal artery (PI) was 2.81 (fig. 3).

Case No. 3: A 36 year old pregnant lady, examined at 32 weeks of gestation with increased amount of amniotic fluid, AFI was 27, fetal renal artery (RI) was 0.98, and fetal renal artery (PI) was 2.49 (fig. 4).

Table (1): Comparison between groups according to maternal age :

Age	Group I: Normal (N=20)	Group II: <u>Oligohydramnios</u> (N=20)	Group III: Polyhydraminos (N=20)	Test	p-value
Age (years)					
Mean±SD	27.950±5.137	29.050±6.837	28.750±6.093	F=0.051	0.950
Range	21-35	20-39	22-37		

F: A one-way analysis of variance (ANOVA)

SD: Standard deviation

Table (2): Comparison between groups according to parity :

Parity	Group I: Normal (N=20)	Group II: Oligohydramnios (N=20)	Group III: Polyhydramnios (N=20)	Test	p-value
Parity					
Median (IQR)	2 (2)	3 (1)	2 (2)	H=0.559	0.575
Range	0-5	0-4	0-4		

H: Kruskal Wallis H test

IQR: Interquartile range

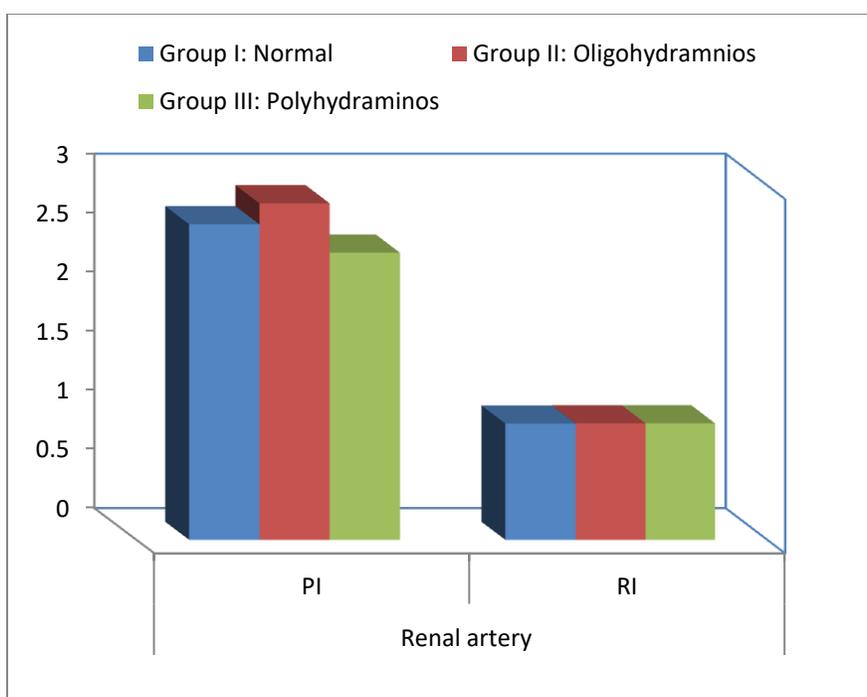


Fig. (1): Bar chart between groups according to renal artery Doppler indices.

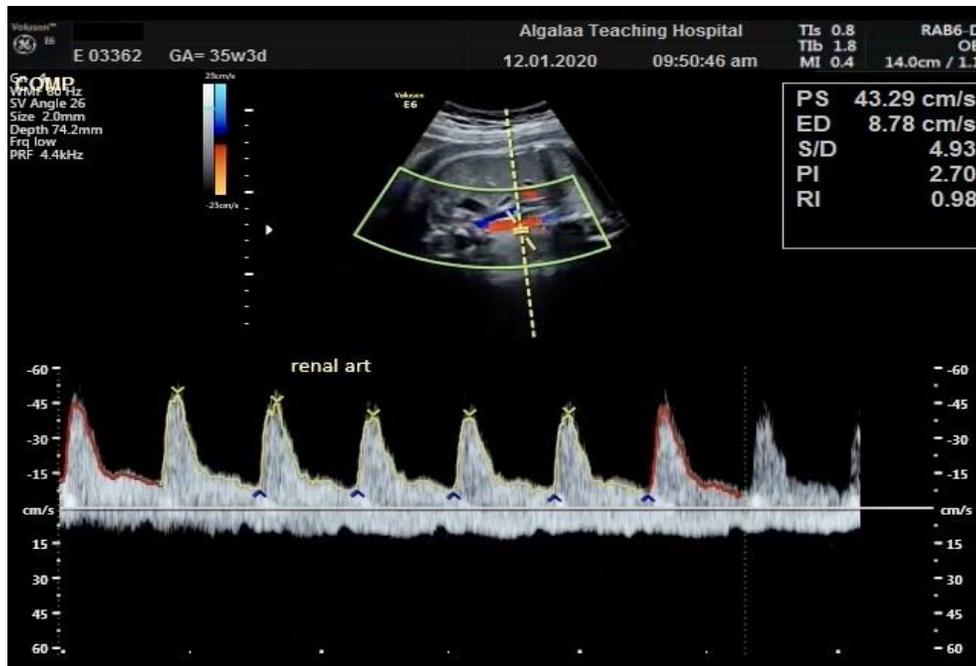


Fig. (2) : Case no. 1, normal AFI.

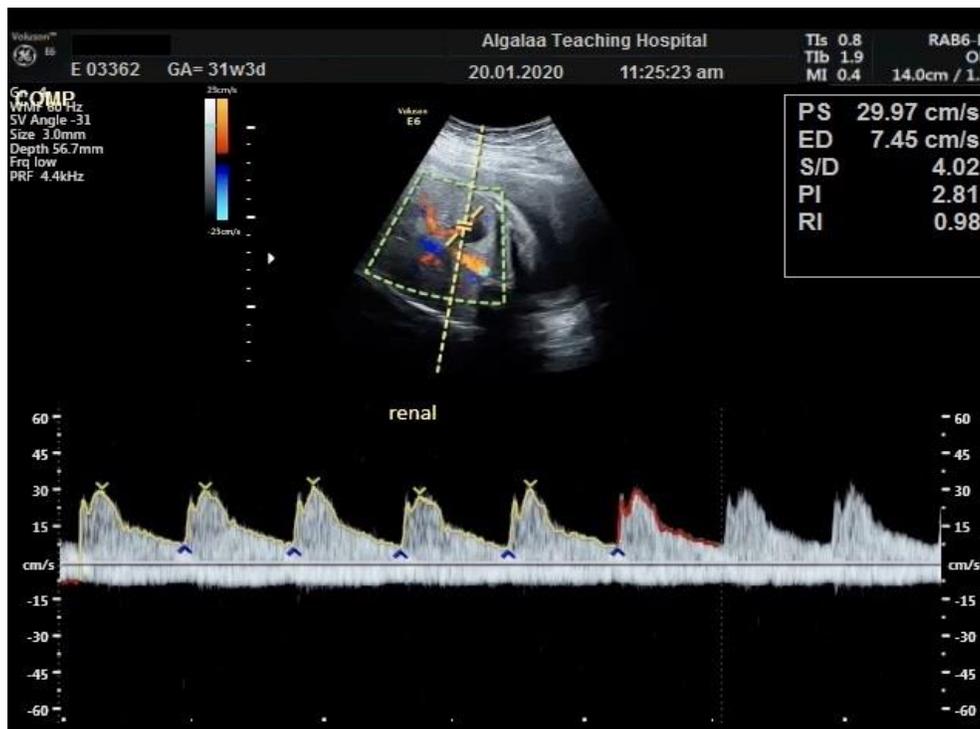


Fig. (3) : Case no. 4, decreased AFI (Oligohydramnios).

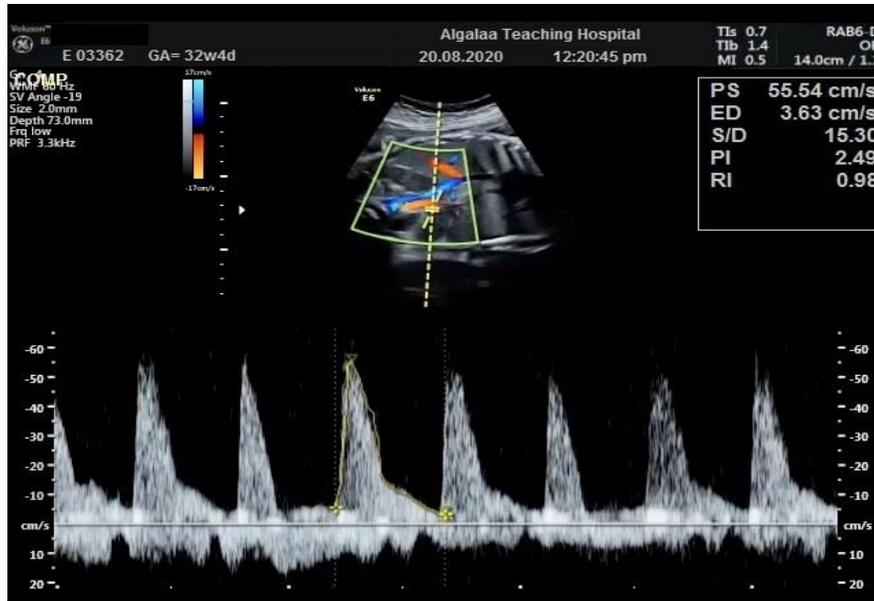


Fig. (4) : Case no. 7, increased AFI (Polyhydramnios).

Discussion

In the current study, the age of the 60 pregnant ladies ranged from 20-40 years old with the mean value of 28.16 years and a mean value of 29.5.

These results were in agreement with other studies where the range age of the pregnant females were from 17-44 years old with a mean value of 28.4, from 18-35 years old with a mean value of 25.21, 15-31 years old and the mean value was 24.71 and 27 ± 3 , respectively (1, 8, 6 7)

In the current study the gestational age ranged from 28 -38 weeks with the mean value of 31.2 years and a mean value of 33.

These results were in agreement with the other studies with a gestational age ranged from (20 and 42) weeks and that with a gestational age ranging from 22-34 weeks. (6 & 1)

While the results of the current study were not in agreement with the studies done on an older fetal age ranged from 38-42 gestational weeks and from (40.1 - 41.3) gestational weeks, respectively (2 & 9)

In the current study there was insignificant difference ($p>0.05$) in the renal artery restrictive index (RI) values between the three studied groups.

These results were in agreement with the results others in which the RI ratio was (0.99 ± 0.02) in all groups (1) and the second study, where the RI was 0.8 in all groups (10)

In cases of oligohydramnios, the RI ratio significantly higher (9 & 11)

In the current study the renal artery pulsatility index (PI) values of the normal cases were significant

These results were in agreement with the results in a study (1) in which renal artery PI values were higher in oligohydramnios cases. The PI value was statistically significant ($P = 0.011$). In pregnancies developing polyhydramnios, renal artery PI values were lower,

The results of the current study were in agreement with the results in the study of the studies done previously (10 & 12) in which the Fetal renal artery PI ratio was higher than normal in oligohydramnios cases, and was statistically significant ($p < 0.05$), with a higher rate of cesarean section deliveries and in cases of polyhydramnios PI values were lower.

Conclusion

There is a relation between renal artery flow velocity waveforms and Amniotic fluid index, whether normal, oligohydramnios or polyhydramnios, using Pulsed wave Doppler Ultrasonography. An increase in Renal Artery PI value develops in relation to decreased AFI (Oligohydramnios) especially in the third trimester, which may be an indicator for rapid delivery to save the life of the fetus. Oligohydramnios could be predicted according to changes in the Renal artery PI values. In pregnancies with increased AFI (Polyhydramnios), Renal artery PI values were decreased.

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