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Abnormal fetal Renal Artery Doppler. Is It an Early Marker of fetal hypoxemia?

M.K.El Manshy, A.M.Elewa, M.F.El Sherbeiny and M.A.EL Sayed
Obstetrics and Gynecology,Dept., Faculty of Medicine, Benha Univ., Benha, Egypt
E-mail: Mohamed.elmanshy1985@gmail.com

Abstract

Background: The fetus receives its oxygen supply across the placenta, to which oxygen is delivered by maternal blood. The amount of oxygen delivered to the placental site is determined by the magnitude of blood flow and the oxygen content of uterine arterial blood. Intrauterine hypoxia is a significant clinical challenge in obstetrics that affects both the pregnant mother and fetus. Intrauterine hypoxia can occur in pregnant women living at high altitude and/or with cardiovascular disease. Fetal renal arterial resistance index decreases moderately during the third trimester of pregnancy, possibly related to the increased blood flow of the renal circulation. The aim of this work is to study fetal Renal Artery Doppler in normal and high risk pregnancy. The validity of abnormal renal artery doppler in late weeks of pregnancy as a marker of fetal hypoxia will be assessed in relation to umblical artery and MCA doppler indices. Methods: This was randomized prospective observational study was conducted at the Obstetrics and Gynecology Department, Benha University Hospital including 120 women attending the antenatal care clinic with pregnancy of more than 34 weeks of gestation referred after acquiring all the necessary formalities as pre- conception & prenatal tests as high-risk pregnancy or for routine ANC. The duration of the study had been from 6 to 12 months. Results: Women's complication in Uncomplicated Group show that 9(27.3%) with no complication, 4(12.1%) had Oligohydramnios and 20(60.6%) had Small for gestational age fetus while in Complicated Group 37(42.5%) with no complication, 34(39.1%) had high blood pressure and 16(18.4%) had Small for gestational age fetus. There was statistically significant differences between groups where P<0.001. Women's Renal Artery PI in Uncomplicated Group was ranged between 1.60 – 2.05 with mean±S.D. 1.804±0.150 while in Complicated Group was ranged between 1.60 – 2.05 with mean±S.D. 1.836±0.125. There was no statistically significant differences between groups where P=0.279. Women's Renal Artery Vmax in Uncomplicated Group was ranged between 5.54 – 8.54 with mean±S.D. 7.046±0.888 while in Complicated Group was ranged between 5.52 – 8.54 with mean±S.D. 7.100±0.901. There was no statistically significant differences between groups where P=0.770. Women's UMA PH in Uncomplicated Group was ranged between 6.20-9.90 with mean±S.D. 7.885±1.239 while in Complicated Group was ranged between 6-9.90 with mean±S.D. 7.905±1.182. There was no statistically significant differences between groups where P=0.885. Women's Fetal Outcome (Apgar score) in Uncomplicated Group was ranged between 5-10 with mean±S.D. 7.61±1.802 while in Complicated Group was ranged between 5-10 with mean±S.D. 7.49±1.718. There was no statistically significant differences between groups where P=0.745. Conclusion: Reduction in the percentage of cardiac output directed towards the kidneys in cases of fetal hypoxemia leads to increased fetal renal artery pulsatility index with decreased renal perfusion. This decreased renal perfusion could be responsible for impaired nephrogensis and decreased kidney volume in fetuses with intrauterine growth restriction.

Key words: Abnormal fetal Renal Artery Doppler, Early Marker, fetal hypoxemia**.**

1. Introduction

Oxygenation is the process of transporting molecular oxygen from air to the tissues of the body. In the fetus, this involves, first, oxygen transfer across the placenta, second, reversible binding of oxygen to fetal hemoglobin and fetal blood flow and, third, oxygen consumption for growth and metabolism. Energy is derived from the combination of oxygen and glucose to form carbon dioxide and water. Removal of carbon dioxide and protection against acidosis is by the reverse of the mechanisms for oxygen delivery and is helped by the rapid diffusion, high solubility and volatility of this gas. In the adult, carbon dioxide is excreted in the lungs while bicarbonate and hydrogen ions are removed by the kidney. In the fetus, both these functions are carried out by the placenta [1].

Fetal hypoxia, oxygen deficiency in the tissues, of any cause leads to a conversion from aerobic to anaerobic metabolism, which produces less energy and more acid. If the oxygen supply is not restored, the fetus dies. Hypoxia may result from: Reduced placental perfusion or reduced arterial blood oxygen content or reduced blood flow to the fetal tissues (ischemic hypoxia). [2]

Small-for-gestational age fetuses may be constitutionally small, with no increased perinatal death or morbidity, or they may be growth-restricted due to either low growth potential, the result of genetic disease or environmental damage, or due to reduced placental perfusion and uteroplacental insufficiency' [3].

Doppler flow velocity waveform analysis of fetal vessels is one of the main methods for evaluating fetus health before labor [4]. Doppler velocimetry of utero-placental vessels identifies alterations of placental perfusion and is valuable in the assessment of fetal brain, heart, and liver perfusion. Doppler velocimetry does not only facilitate judgment in diagnosis and monitoring of fetal wellbeing during pregnancy and labor but also has a role in the early detection of fetal hypoxia [5]

Towards term, the resistance in the renal artery falls thus directing more blood towards the kidneys which is reflected by increase in end diastolic velocity and mean velocity. However peak systolic velocity shows only minor changes. [6]

In fetal hypoxemia, there is an increase in the blood supply to the brain, myocardium, the adrenal glands and spleen (decreased PI in cerebral, coronary, splenic and

adrenal arteries) and reduction in the perfusion of the kidneys, gastrointestinal tract and the lower extremities (increased PI in descending aorta, renal and femoral artery) . [7]

In these cases, fetal renal Doppler shows increased resistance in the form of raised pulsatility and resistivity index. Thus stating direct relationship between fetal hypoxia and renal artery resistance. [1]. The significance of Doppler ultrasound in evaluating pregnancies that have the risk for preeclampsia, intrauterine growth restriction, fetal anaemia, and umbilical cord abnormalities has become indispensable [8]. Fetal metabolic stress, triggers apoptosis in a variety of tissues, including the nervous system and the kidney [9].

A direct measure of renal blood flow would be renal artery PI. In El Behery et al 2012 study renal artery flow resistance changes appears earlier than change in umbilical arterial flow. Running in agreement with a previous study which showed that the renal artery flow resistance already deviates significantly from the normal range, while that for the umbilical artery is in the normal field [10].

The aim of this work is to study fetal Renal Artery Doppler in normal and high risk pregnancy. The validity of abnormal renal artery doppler in late weeks of pregnancy as a marker of fetal hypoxia will be assessed in relation to umblical artery and MCA doppler indices. The impact of abnormal doppler of fetal arteries on the renal and fetal circulation, amniotic fluid index, birth weight, and fetal condition at birth will be evaluated in both complicted and uncomplicated pregnancies.

2. Patients and Methods

2.1. Type of study

This was randomized prospective observational study

Study setting

The study had been conducted at the Obstetrics and Gynecology Department, Benha' University Hospital, Benha– Egypt through the period from November 2018 till the required number was fulfilled.

Ethical consideration:

The study protocol had been approved by the Hospital Research and Ethics Committee and an informed written consent had been obtained from all participants before enrolment in the study.

Study population

The study had been included 120 women attending the antenatal care clinic with pregnancy of more than 34 weeks of gestation referred after acquiring all the necessary formalities as pre- conception & prenatal tests as high risk pregnancy or for routine ANC.

2.2Inclusion Criteria

1. Singleton fetus of more than 34 weeks gestational age.
2. Pregnancy with low risk factors. (low-risk pregnancy).
3. Pregnancy with One or more of the following complications (High-risk pregnancy):
   - Small for gestational age fetus.
   - Oligohydramnios.
   - Hypertension with pregnancy.
   - Diabetes Mellitus with pregnancy.
   - Placental vascular dysfunction documented by abnormal umbilical artery Doppler indices

2.3. Exclusion criteria

- Pregnant ladies of uncertain dates whose gestational age was not confirmed by previous ultrasound
- Fetuses with structural anomalies both renal and non-renal, unclear renal margins and poorly visualized kidneys.
- Fetus with major congenital malformations confirmed by ultrasound examination.
- Multiple pregnancy.
- Patient planned for Emergency or elective termination of current pregnancy

2.3. Operational design

Explanation of the nature of the procedure to all women participating in the study and an informed written consent was taken from all patients before starting the study with counseling about risk and benefit of the study.

2.4Methods

Patients were subjected to:

Complete history taking:

- Personal history including
- Name, Age, marital state, address menstrual history: including age of Menarche, menstrual disturbance, dysmenorrhea, related symptoms.
- Obstetric history including parity and mode of delivery.
- Present history: of chronic diseases and medication.
- Past history of HTN, DM.
- Family history of similar condition or diabetes.
- History of allergy to any medication.
- Surgical history of operation, laparoscopic interference, treatment of hirsutism by Laser.

Examination

A. General examination:

1) Evaluation of vital signs,

2) measurement weight, height (BMI)

B. Abdominal and local clinical examination:

- To assess fundal level and gestational age
- Scar of previous operation,
- Mass, tenderness or rigidity,
- Any abdominal or pelvic clinically detectable pathology.

C. Bimanual pelvic examination of both adenexa, and uterus for detection of any abnormality of female genitalia.

D. Ivestigations

- Complete blood count .
- Coagulation profile to exclude any systemic disease.
- Four to six blood units plus four to six fresh frozen plasma units were cross matched.

E. Ultrasound study for assessment of

Fetal biometry including estimated Fetal Weight.

Amniotic fluid index.

F. Doppler Ultrasound study:

Trans-abdominal ultrasound had been performed to all patients while lying in a semirecumbent position with slight lateral tilt with a small pillow under the right buttock.

(Voluson pro – V made in Austalia) ultrasound machine with Doppler unit and a convex linear transducer (3-5 MHZ) will be used.

Together with ultrasound scan ,Doppler study of renal artery,umbilical artery and middle cerebral artery will be scheduled every 2 weeks till delivery, RI, PI and Systolic to Diastolic standard deviation (SD) of consecutive flow velocity waveforms will be calculated.

The angle between the ultrasonographic beam and direction of blood flow should be < 30 degree. The Doppler indices had been calculated by the dedicated software supplied within the Doppler equipment. [(11)]

From the inclusion criteria and after collecting the data, the pregnant women will be rearranged into two groups according to their obstetric performance

1-complicated group(High-risk pregnancy):

Contains "FGR, hypertensive disorder, and vasculopathy that depends on overt diabetes or systemic lupus erythematosis (SLE) or renal disease" .

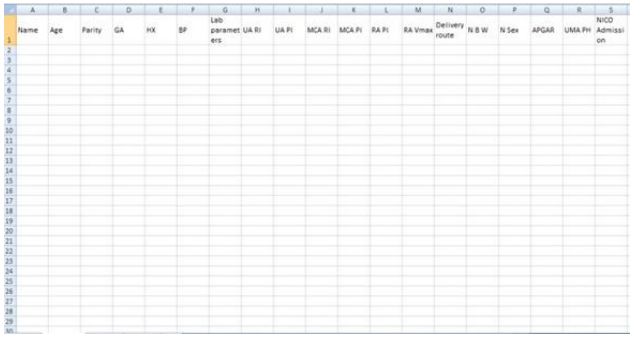
2-uncomplicatedgroup(low-risk pregnancy):

In both groups, these parameters will be interpreted

A. Any antenatal complications.
B. Labor and possible intrapartum events.
C. Results of the Doppler ultrasound (MCA RI and PI umbilical RI and PI and renal artery PI and V max
D. Neonatal outcome:-that will contain
- Neonatal body weight (NBW).
- Fetal sex.
- APGAR scoring
- ✓Cord blood pH.
- ✓NICU admission.
- Neonatal follow up in the first 24 hrs.

The neonate was poor outcome if pH <7.2 and NBW <2500 g and NICU admission after birth [(12).]

.N.B : All data of cases had been collected in a Working sheet.



2.5. Statistical analysis

The clinical data will be recorded on a report form. These data will be tabulated and analyzed using the computer program SPSS (Statistical package for social science) version 21 to obtain: descriptive data, analytical statistics By using one or more of the following statistical tests: Student's t-test and Mann-Whitney test- Paired t test and willcoxon test, ANOVA test (F value) and kruskal-wallis test - Z test- Inter group comparison of categorical data will be performed by using chi square test (X2-value) and fisher exact test (FET). Correlation coefficient. P value <0.05 will be considered statistically significant (S) while >0.05 is statistically insignificant P value <0.01 will be considered highly significant (HS) in all analyses (13, 14)

3. Results

Women's gravity in Uncomplicated Group was ranged between 1 – 3 with a mean of 2.15±0.795 while in Complicated Group was ranged between 1 – 3 with a mean of 2.11±0.827. There were no statistically significant differences between groups where P=0.851.Table (1 (

Women's parity in Uncomplicated Group was ranged between 0 – 2 with a mean of 0.73±0.674 while in Complicated Group was ranged between 0 – 2 with a mean of 0.78±0.738. There were no statistically significant differences between groups where P=0.779. Table (1).

Table (1) Comparison between two groups as regard to gravity and parity

	Uncomplicated Group (n=32)	Complicated Group (n=88)	P-Value
Gravity			
Min. – Max.	1 – 3	1 – 3	0.851
Mean±S.D	2.15±0.795	2.11±0.827	
Parity			
Min. – Max.	0 – 2	0 – 2	0.779
Mean±S.D	0.73±0.674	0.78±0.738	

Women's complication in Uncomplicated Group show that 9(27.3%) with no complication, 4(12.1%) had Oligohydramnios and 20(60.6%) had Small for gestational age fetus while in Complicated Group 37(42.5%) with no complication, 34(39.1%) had high blood pressure and 16(18.4%) had Small for gestational age fetus. There was statistically significant differences between groups where P<0.001 Table (2).

Table (2) Comparison between two groups as regard to patient's complication.

Complication	Uncomplicated Group (n=32)		Complicated Group (n=88)		P Value
	No.	%	No.	%	
No	9	27.3	37	42.5	<0.001*
High Blood Pressure	0	0	34	39.1	
Oligohydramnios	4	12.1	0	0	
Small for gestational age fetus	20	60.6	16	18.4	

Women's umbilical RI in Uncomplicated Group was ranged between 0.56 – 0.86 with mean± S.D. 0.709±0.086 while in Complicated Group was ranged between 0.56 – 0.86 with mean± S.D. 0.715±0.084. There were no statistically significant differences between groups where P=0.737. There were no statistically significant differences regarding women's umbilical PI between groups where P=0.955. Table (3).

Women's MCA RI in Uncomplicated Group was ranged between 0.70 – 0.89 with mean± S.D. 0.796±0.046 while in Complicated Group was ranged between 0.70 – 0.90 with mean± S.D. 0.803±0.063. There were no statistically significant differences between groups where P=0.695. There were no statistically significant differences regarding women's MCA PI between groups where P=0.630 **Table (3)**.

Women's Renal Artery PI in Uncomplicated Group was ranged between 1.60 – 2.05 with mean± S.D. 1.804±0.150 while in Complicated Group was ranged between 1.60 – 2.05 with mean± S.D. 1.836±0.125. There were no statistically significant differences between groups where P=0.279. There were no statistically significant differences regarding women's renal artery Vmax between groups where P=0.770 Table (3).

Table (3) Comparison between two groups as regard to patient's doppler results

	Uncomplicated Group (n=32)	Complicated Group (n=88)	P Value
Umblilical RI			
Min.-Max.	0.56 – 0.86	0.56 – 0.86	0.737
Mean± S.D	0.709±0.086	0.715±0.084	
Umblilical PI			
Min.-Max.	0.90 – 1.70	0.90 – 1.77	0.955
Mean± S.D	1.348±0.251	1.343±0.257	
MCA RI			
Min.-Max.	0.70 – 0.89	0.70 – 0.90	0.695
Mean± S.D	0.796±0.046	0.803±0.063	
MCA PI			
Min.-Max.	1.61 – 2.05	1.60 – 2.05	0.630
Mean± S.D	1.833±0.141	1.821±0.122	
Renal Artery PI			
Min.-Max.	1.60 – 2.05	1.60 – 2.05	0.279
Mean± S.D	1.804±0.150	1.836±0.125	
Renal Artery V_{max}			
Min.-Max.	5.54 – 8.54	5.52 – 8.54	0.770
Mean± S.D	7.046±0.888	7.100±0.901	

Women's UMA PH in Uncomplicated Group was ranged between 6.20-9.90 with mean±S.D. 7.885±1.239 while in Complicated Group was ranged between 6-9.90 with mean±S.D. 7.905±1.182. There was no statistically significant differences between groups where P=0.885. Table (4)

Table (4) Comparison between two groups as regard to patient's UMA PH.

UMA PH	Uncomplicated Group (n=32)	Complicated Group (n=88)	P Value
Min.-Max.	6.20 – 9.90	6 – 9.90	0.885
Mean± S.D	7.885±1.239	7.905±1.182	

Women's birth weight in Uncomplicated Group was ranged between 2000-3000 gm with mean±S.D. 2418.18±335.833 gm while in Complicated Group was ranged between 2000-3000 gm with mean±S.D. 2435.63±308.401 gm. There was no statistically significant differences between groups where P=0.692. Table (5)

Table (5) Comparison between two groups as regard to patient's birth weight.

Birth Weight (gm)	Uncomplicated Group (n=32)	Complicated Group (n=88)	P Value
Min.-Max.	2000-3000	2000-3000	0.692
Mean± S.D	2418.18±335.833	2435.63±308.401	

Women's Fetal Outcome (APGAR score) in Uncomplicated Group was ranged between 5-10 with mean±S.D. 7.61±1.802 while in Complicated Group was ranged between 5-10 with mean±S.D. 7.49±1.718. There was no statistically significant differences between groups where P=0.745. **Table (6)**

Table (6) Comparison between two groups as regard to patient's Fetal Outcome (APGAR score).

Fetal Outcome (APGAR score)	Uncomplicated Group (n=32)	Complicated Group (n=88)	P Value
Min.-Max.	5-10	5-10	0.745
Mean± S.D	7.61±1.802	7.49±1.718	

Women's Child Gender in Uncomplicated Group show that 13(39.4%) were male and 20(60.6%) were female while in Complicated Group 49(56.3%) were male and 38(43.7%) were female. There was no statistically significant differences between groups where P=0.107. **Table (7)**

Table (7) Comparison between two groups as regard to patient's Child Gender.

Child Gender	Uncomplicated Group (n=32)		Complicated Group (n=88)		P Value
	No.	%	No.	%	
Male	13	39.4	49	56.3	
Female	20	60.6	38	43.7	0.107
Total	32	100	88	100	

Women's NICU Admission in Uncomplicated Group show that 26(78.8%) didn't need to admitted in NICU and 7(21.2%) had to admitted in NICU while in Complicated Group 74(85.1%) didn't need to admitted in NICU and 13(14.9%) had to admitted in NICU. There was no statistically significant differences between groups where P=0.420. Table (8)

Table (8) Comparison between two groups as regard to patient's NICU Admission.

NICU Admission	Uncomplicated Group (n=32)		Complicated Group (n=88)		P Value
	No.	%	No.	%	
No	26	78.8	74	85.1	0.420
Yes	7	21.2	13	14.9	
Total	32	100	88	100	

4. Discussion

Women's complication in Uncomplicated Group show that 9(27.3%) with no complication, 4(12.1%) had Oligohydramnios and 20(60.6%) had Small for gestational age fetus while in Complicated Group 37(42.5%) with no complication, 34(39.1%) had high blood pressure and 16(18.4%) had Small for gestational age fetus. There was statistically significant differences between groups where P<0.001.

Azpurua et al., [15] found that out of the 56 women who presented with clinical signs or symptoms of preterm labor (study group), 19 (34%) had AF proteomic profiles characteristic of intra-amniotic inflammation. All 19 women had a clinically indicated preterm delivery.

Terstappen et al., [16] reported that no maternal comorbidities were present in the control group, while in the FGR group, one pregnancy was complicated by a thyroid disorder and one by pre-existing hypertension. Seven of the FGR neonates' mothers experienced pre-eclampsia. More antihypertensive drugs and fewer antibiotics were used in pregnancies complicated by FGR than in controls.

The present study shows that women's gravity in uncomplicated group was ranged between 1 – 3 with a mean of 2.15±0.795 while in complicated group was ranged between 1 – 3 with a mean of 2.11±0.827. There were no statistically significant differences between groups where P=0.851. Women's parity in uncomplicated group was ranged between 0 – 2 with a mean of 0.73±0.674 while in complicated group was ranged between 0 – 2 with a mean of 0.78±0.738. There were no statistically significant differences between groups where P=0.779.

Our results are in agreement with study of Sanad et al., [17] as they reported that there was no statistically

significant difference among both groups regarding maternal age and parity.

Furthermore, Azpurua et al., [15] found that control women were of lower parity, more frequently Hispanic, had longer ultrasound-to delivery intervals and larger neonates at birth. There was no difference in GA at enrollment between the study and control groups.

Renal pathology often emerges in the latter half of pregnancy, and alterations in fetal renal size may provide useful prognostic information. In addition, blood supply to the kidneys is one of most important factors affecting development. Renal vascularization indexes were inversely correlated with ductus venosus plasticity indexes and were diminished in fetuses showing hemodynamic compromise. These changes might be related to postnatal renal impairment [18].

The current study shows that women's umbilical RI in Uncomplicated Group was ranged between 0.56 – 0.86 with mean± S.D. 0.709±0.086 while in Complicated Group was ranged between 0.56 – 0.86 with mean± S.D. 0.715±0.084. There were no statistically significant differences between groups where P=0.737. There were no statistically significant differences regarding women's umbilical PI between groups where P=0.955. UMA PH in Uncomplicated Group was ranged between 6.20-9.90 with mean± S.D. 7.885±1.239 while in Complicated Group was ranged between 6-9.90 with mean± S.D. 7.905±1.182. There were no statistically significant differences between groups where P=0.885.

Women's MCA RI in Uncomplicated Group was ranged between 0.70 – 0.89 with mean± S.D. 0.796±0.046 while in Complicated Group was ranged between 0.70 – 0.90 with mean± S.D. 0.803±0.063. There were no statistically significant differences between groups where P=0.695. There were no statistically significant differences regarding women's MCA PI between groups where P=0.630.

Women's Renal Artery PI in Uncomplicated Group was ranged between 1.60 – 2.05 with mean± S.D. 1.804±0.150 while in Complicated Group was ranged between 1.60 – 2.05 with mean± S.D. 1.836±0.125. There were no statistically significant differences between groups where P=0.279. There were no statistically significant differences regarding women's renal artery Vmax between groups where P=0.770.

Our results are in line with study of Sanad et al., [17] as their results show no statistically significant difference between groups according to renal and UA Doppler indices at the gestational age of 22 weeks. Their results show no statistically significant difference between groups according to RA Doppler indices PI and UA Doppler indices RI at the gestational age of 28 weeks. Their results show statistically significant difference between groups according to UA Doppler indices PI and RI at the gestational age of 34 weeks.

Tsai & Chang, [19] revealed that the fetal renal VI (Vascularization index), FI (Flow index), and VFI (Vascularization-flow index) in FGR fetuses were significantly smaller than in non-FGR fetuses.

Regarding Terstappen et al., [16], the renal ultrasound was performed at a similar mean time after birth (FGR: 15.0 ± 2.9 hours after birth vs. control 13.9 ± 2.7 hours after birth; p = 0.80). No significant differences were found in pulsatility index and lower resistance index of the renal artery or kidney length in FGR vs. control neonates.

Furthermore, El Behery et al., [20] revealed that umbilical and middle cerebral artery PI showed no significant differences between normally grown fetuses and those with IUGR. On the other hand, renal artery pulsatility index was significantly elevated in group 2 than in group1 P<0.001. This was in agreement with a previous study that showed no association between umbilical, and middle cerebral artery PI and kidney volume. However, in their study the authors found cerebro-umbilical ratio to be negatively associated with renal volume (14).

A direct measure of renal blood flow would be renal artery PI. In El Behery et al., [20] study renal artery flow resistance changes appear earlier than change in umbilical arterial flow. Running in agreement with a previous study which showed that the renal artery flow resistance already deviates significantly from the normal range, while that for the umbilical artery is in the normal field (10). Likewise, they showed that adverse blood flow resistance patterns of the renal artery expressed as increased PI was negatively correlated to kidney volume, independent of fetal abdominal circumference at the time of the kidney measurement. This implies that kidney volume did not solely depend on abdominal circumference or overall fetal size but to some extent directly on blood flow redistribution with resultant increased intra renal resistance.

Similar results were obtained in a study done by Benzer et al., [21]. Intermittent assessment of RA flow velocity waveforms during the early stages of pregnancy may help in predicting changes in amniotic fluid dynamics. This study sought to determine the relation of RA and UA flow velocity waveforms with normal pregnancies and pregnancies complicated by either polyhydramnios or oligohydramnios. Renal and UA Doppler values were evaluated at 22, 28, and 34 weeks of gestation in 300 low-risk pregnant women with singleton pregnancies. PI and RI were recorded, and the amniotic fluid volume was evaluated. Three groups were formed according to the amniotic fluid volume at birth. Group I consisted of 264 pregnant women with normal amniotic fluid, group II included 30 pregnant women with oligohydramnios, and group III included six pregnant women with polyhydramnios. Doppler parameters were compared between the groups and within each group according to gestational age. RA PI values were higher in group II than group I at 22, 28, and 34 weeks. The PI value at 28 weeks of gestation was statistically significant (P = 0.011). At 28 weeks of gestation, group II also had higher UA PI and RI values than group I.

Benavides-Serralde et al., [22] reported lack of association of the RA PI with SGA fetuses and that the RA PI has the lowest sensitivity and specificity for

detection of adverse neonatal outcomes. The increasing RA PI occurring with gestational age that we have documented is not consistent with early reports in the literature regarding the RA PI, which was reported to decrease especially among fetuses with growth restriction. These differences could be attributed to the gestational age of the population included or to the references use [23].

The present study shows that women's women's birth weight in Uncomplicated Group was ranged between 2000-3000 gm with mean±S.D. 2418.18±335.833 gm while in Complicated Group was ranged between 2000-3000 gm with mean±S.D. 2435.63±308.401 gm. There were no statistically significant differences between groups where P=0.692.

Our results are supported by study of Verburg et al., [14] as they observed that there were no statistically significant differences between groups as regard birth weight.

Findings of our results not coincided with study of Sanad et al., [17] as they reported that there was a high statistically significant difference between groups according to birth weight.

In the study in our hands, women's Fetal Outcome (APGAR score) in Uncomplicated Group was ranged between 5-10 with mean±S.D. 7.61±1.802 while in Complicated Group was ranged between 5-10 with mean±S.D. 7.49±1.718. There were no statistically significant differences between groups where P=0.745.

Women's Child Gender in Uncomplicated Group show that 13(39.4%) were male and 20(60.6%) were female while in Complicated Group 49(56.3%) were male and 38(43.7%) were female. There were no statistically significant differences between groups where P=0.107.

Women's NICU Admission in Uncomplicated Group show that 26(78.8%) didn't need to admitted in NICU and 7(21.2%) had to admitted in NICU while in Complicated Group 74(85.1%) didn't need to admitted in NICU and 13(14.9%) had to admitted in NICU. There were no statistically significant differences between groups where P=0.420.

Our results are supported by study of Azpurua et al., [15] as they reported that there were no statistically significant differences between groups as regard APGAR score. Furthermore, Terstappen et al., [16] found that there were no statistically significant differences between groups as regard APGAR score and child gender.

5. Conclusion

Reduction in the percentage of cardiac output directed towards the kidneys in cases of fetal hypoxemia leads to increased fetal renal artery pulsatility index with decreased renal perfusion. This decreased renal perfusion could be responsible for impaired nephrogensis and decreased kidney volume in fetuses with intrauterine growth restriction.The RA Doppler resistance indices do not seem to improve identification of the SGA fetus with growth restriction or improve prediction of fetuses at risk for adverse neonatal outcomes.

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