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Comparative Assessment of Ultrasound Placental Findings in Small for Gestational Age and Normal-Weight Fetuses

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Abstract

Background

Small for gestational age (SGA) refers to newborns whose birth weight is less than the 10th percentile for gestational age. The aim of this study was to provide a comparative assessment of ultrasound placental findings in SGA and normal-weight fetuses in singleton pregnant women.

Materials and Methods

In this cross-sectional study, a total number of 112 singleton pregnant women who were in their second trimester and referred to Shariati and Imam Khomeini hospitals, Tehran, Iran, during 2016-17 were selected. Ultrasound placental findings were assessed in SGA and normal-weight fetuses. Fetal and maternal indices were also assessed. Data were analyzed using SPSS software (version 16.0).

Results

There was a significant relationship between maternal age and IUGR (0.026); while no significant relationship was found between gestational age and IUGR (p=0.185). No statistically significant difference existed between male and female fetuses in terms of IUGR (p=0.542). The highest artery Doppler systolic-diastolic pressure ratio was found in EFW<5th percentile which showed a statistically significant difference with other groups (p<0.01). Uterine artery resistance indices (UARI) in <5th percentile and >90th percentile groups were the highest and lowest respectively with a statistically significant difference with other groups (p<0.01). Amniotic fluid index was the lowest in 5-10th percentile and <5th percentile groups (p<0.01).

Conclusion

Based on the results, SGA incidence was significantly related to maternal pregnancy age, artery Doppler systolic-diastolic pressure ratio, UARI, AFI, and placental thickness. As such, ultrasound methods can be employed during pregnancy to detect SGA incidence.

Key Words: Maternal age, Newborn, Small for Gestational Age, Pregnant women.

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1- INTRODUCTION

Birth weight is an important factor in the fate of a pregnancy and the rate of prenatal morbidity and mortality increases with abnormal fetal weight (1). Low or excessive birth weight also leads to increased neonatal risks during labor and around the time of birth (2). SGA refers to newborns whose birth weight is less than the 10th percentile for gestational age (3). The likelihood of mortality, hospitalization in neonatal intensive care unit, and the length of stay increase in these newborns (4). There will also be the chance of increased chronic diseases in later years such as type 2 diabetes, hypertension, fatness, cardiovascular diseases, and mental problems (5-8). In women with SGA and intrauterine fetal death simultaneously, the risk of intrauterine fetal death will increase in the next pregnancy (9). Ultrasound estimation of fetal weight from measurement of biometric parameters is important in assessment of continuing the pregnancy with conservative treatment or terminating the pregnancy. Detection of SGA before birth leads to better surveillance during childbirth (10, 11).

Young mothers, weight gain disorders during pregnancy, nutritional disorders, low social-economic class, fetal infections, fetal abnormalities, anticonvulsants, smoking, alcohol, drugs, maternal high blood pressure, chronic renal diseases, maternal anemia, multiple births, and placental and umbilical cord abnormalities are among the underlying and risk factors for the incidence of Intrauterine growth restriction (IUGR), and SGA (12). IUGR is reported 7 to 17.4 percent in the USA (13). It is possible to detect IUGR before birth by clinical examination of pregnant women with sonography (3). Prevention of high-risk pregnancies, receiving necessary care and application of appropriate treatments may reduce SGA. Research on 768 pregnant women at 26-34 weeks gestational age showed that abdominal circumference and estimated fetal weight could predict the incidence of SGA (14). Similar results were reported in a study on 1,727 pregnant women (15). Recent findings showed that 7.8% of newborns mortality were related to SGA and 3.8% to fetal growth restriction (FGR) (16). The purpose of the present study was to compare ultrasound placental findings in SGA and normal-weight fetuses in singleton pregnant women who

2- MATERIALS AND METHODS

2-1. Study design and population

The study is a descriptive, cross-sectional research. Statistical population included singleton pregnant women in their second trimester who were hospitalized in delivery wards of Shariati and Imam Khomeini Hospitals, Tehran, Iran, to terminate their pregnancy for any reason. In addition, the frequency of weight<10th percentile was investigated in these women.

2-2. Methods

This study was conducted on singleton pregnant women who referred to Shariati and Imam Khomeini Hospitals, Tehran, Iran, in their second trimester during 2016-17. Sample size was based on previous studies (17), considering 95% confidence level (CI), and 80% sensitivity for clinical methods of fetal weight estimation. During the study, 112 women were examined by means of ultrasound scans and were compared in terms of ultrasound placental findings and fetal weight. All ultrasound scans were performed by one individual using a Siemens ultrasound machine.

2-3. Laboratory measurements

The following variables were examined during the study: maternal age, gestational age, number of pregnancies, number of live pregnancies over 20 weeks, number of live births, abortion, cause of pregnancy

termination, type of delivery, fetal age, fetal abdominal circumference, gestational age percentile, estimated fetal weight, estimated fetal weight percentile, maximum systolic flow, uterine artery Doppler systolic-diastolic pressure ratio, uterine artery resistance indices, uterine artery pulsatility index, middle cerebral artery Doppler, middle cerebral artery Doppler resistance index, middle cerebral artery Doppler pulsatility index, amniotic fluid index, thickness, grid, type and location of placenta, location of umbilical cord, placental abnormality, placental vascular tumor, first and fifth minute Apgar scores, birth weight, and neonate's gender.

2-4. Inclusion and exclusion criteria

Inclusion criteria included: pregnant women in their second trimester of pregnancy, maternal age between 15 and 45 years, acceptance at first stage of delivery, healthy fetus, singleton, live with vertex presentation and no abnormalities in ultrasound, maternal body mass index (BMI) less than 30 kg/m^2, no sac rupture at the onset of active phase and no uterine malformations. Subjects were excluded if they had a history of medical problems during pregnancy, congenital malformations, or neonatal death.

2-5. Ethical consideration

The protocol of the study was approved by the Ethics Committee of Hamedan University of Medical Sciences by ethical code number 1398.16/35/10/62. All patient information was kept completely confidential. No additional costs were imposed on the patients. In the course of the project, we adhered to Helsinki Statement. The written informed consent form was obtained from subjects for the study and all stages of the study were explained to them. Individuals were free to withdraw from the study at any time.

2-6. Data Analyses

Data were analyzed in SPSS software version 22.0 using one-way ANOVA, descriptive methods, Chi-square test, Kruskal-Wallis test, and tested for normal distribution using Kolmogorov–Smirnov test. P-value less than 0.05 was statistically significant.

3- RESULTS

Kolmogorov–Smirnov test showed that the variables age and gestational age had normal and non-normal distribution, respectively. There was a significant relationship between maternal age and IUGR (p=0.026); while there was no significant relationship between gestational age and IUGR (p=0.185). Results also showed no statistically significant difference between male and female fetuses in terms of IUGR (p=0.542). **Table.1** shows that the number and length of equivalent chain length (ECL) are not significantly different among the groups (p>0.05).

Table-1: Comparison of the length of ECL among different groups.

Estimated fetal weight percentile	Maternal age, year Mean± SD	Gestational age, month Mean± SD	Fetal gender		Number of ECL	Length of ECL
			Female	Male		
Less than 5	27.36 ± 4.75	33.81 ± 3.63	15	18	1.92±1.07	10.24 ± 5.53
Between 5-10	26.50 ± 3.95	35.18 ± 2.71	6	5	1.80±0.44	6.65 ± 1.96
In range 10-90	27.33 ± 4.90	36.08 ± 6.62	27	36	1.90±0.76	10.49 ± 5.40
Over 90	33.12 ± 4.48	37.37 ± 4.48	3	5	---	---
P-value	0.601	0.000	0.542		0.959	0.409

SD: standard deviation; ECL: equivalent chain length.

Results showed a significant difference in uterine artery Doppler systolic-diastolic pressure ratio with the highest level in estimated fetal weights (EFW) < 5th percentile which shows a statistically significant difference with other groups (p<0.01). There was also a significant difference among the four groups in UARI with the highest and lowest levels in the <5th percentile, and >90th percentile groups, respectively, showing a statistically significant difference with other groups (p<0.01). Amniotic fluid index was the lowest in 5-10th percentile and <5th percentile groups, and the two 10-90th percentile and >90th percentile groups had a significant difference (p<0.01). Placental thickness had a non-normal distribution and according to the Kruskal-Wallis test, it was significantly smaller in the <5th percentile group than in other groups (p=0.00), but the difference between 5-10th percentile and >10th percentile groups was not significant (p=0.16) (**Table.2**). Results showed a significant relationship between placental type and IUGR (p=0.000), and also between umbilical cord location and IUGR (p=0.007) (**Table.3**). Results showed that there was a significant relationship between placental location and IUGR (p=0.000), and also between fetal abnormality and IUGR (p=0.015) (**Table.4**).

Table-2: The effect of placental thickness on UARI and Amniotic fluid index.

Estimated fetal weight percentile	Doppler art SD	Doppler art RI	Doppler art PI	Doppler MCA	Doppler MCA RI	Doppler MCA PI	AFI	Placental thickness
Less than 5	4.86±3.03a	0.74±0.09a	1.45±0.40a	5.09±2.20a	0.77±0.10b	1.60±0.56a	8.00±3.46b	2.93±5.13a
Between 5-10	3.11±0.10b	0.66±0.10b	1.20±0.31a	7.85±4.44a	3.41±0.25a	1.78±0.25a	6.16±4.09b	6.45±10.63a
In range 10-90	2.77±0.67b	0.64±0.08b	1.14±1.17a	5.37±1.73a	0.80±0.08b	1.78±0.25a	10.73±3.54a	4.49±10.21a
Over 90	2.17±0.35b	0.53±0.07c	0.78±0.19a	6.73±1.66a	0.83±0.03b	8.00±3.46a	11.34±4.07a	7.71±14.24a
P-value	0.000	0.000	0.333	0.058	0.019	0.156	0.000	0.542

UARI: Intrauterine growth restriction; RI: Resistance index; SD: Systolic/diastolic; MCA: Fetal middle cerebral artery; AFI: Amniotic fluid index.

Table-3: The effect of placental type and umbilical cord location on IUGR.

Estimated fetal weight percentile	Placental type		Umbilical cord location			Missing	Grid			
	Abnormal	Normal	Battledore	Eccentric	Centric		0	1	2	3
<5th percentile	28(84.8)	5(15.2)	1(3)	8(24.2)	18(54.5)	6(18.2)	4(12.1)	1(3)	13(39.4)	15(45.5)
5-10th percentile	7(63.6)	4(36.4)	1(9.1)	2(18.2)	7(63.6))	1(9.1)	2(18.2)	1(9.1)	4(36.4)	4(36.4)
10-90th percentile	38(56.7)	29(43.3)	0	8(11.9)	52(77.6)	7(10.5)	17(25.4)	1(1.5)	31(46.3)	18(26.9)
>90th percentile	2(25)	6(75)	0	1(12.5)	6(75)	1(12.5)	1(12.5)	0	7(87.5)	0
Significance	0.000		0.007							

IUGR: Intrauterine growth restriction.

Table-4: The effect of placental abnormalities and location on IUGR.

Estimated fetal weight percentile	Placental abnormalities							Placental location			
	Calcification	Multiple lacunae	Placenta Previa	Multiple infarction	Sub-chorionic hematoma	ECL	Missing	Lateral	Fundal	Posterior	Anterior
<5th percentile	2(13.3)	1(6.7)	1(6.7)	6(40)	0(0)	18(0.0)	5(33.3)	0(0.0)	10(0.0)	12(0.0)	10(0.0)
5-10th percentile	1(16.7)	1(16.7)	0(0)	0(0)	0(0)	5(0.0)	4(66.5)	1(0.0)	0(0.0)	2(0.0)	8(0.0)
10-90th percentile	2(4.5)	4(9.1)	0(0)	6(13.6)	3(6.8)	23(0.0)	29(65.9)	1(0.0)	9(0.0)	17(0.0)	40(0.0)
>90th percentile	2(25)	0(0)	0(0)	0(0)	0(0)	0(0.0)	6(75)	0(0.0)	0(-)	0(0.0)	8(-)
P-value	0.15							0.000			

IUGR: Intrauterine growth restriction; UARI: Intrauterine growth restriction; ECL: Echogenic cystic lesions.

4- DISCUSSION

The purpose of the study was to identify ultrasound placental findings in SGA and normal-weight fetuses. Researchers have reported that prenatal stress, anxiety and depression in the 20th week of gestation increase the risk of SGA. Moreover, the impact of maternal anxiety and depression on SGA is greater in male than in female newborns (18). However, the present study showed that no statistically significant difference existed between male and female fetuses in terms of IUGR (p=0.542). Research shows that the risk of fetal death increases with maternal aging (above 35 years) (19). Researchers have found that in women who get pregnant for the first time in older ages, the risk of SGA rises, but no relationship has been reported between SGA and maternal age in women with multiple pregnancies (20). Other researchers also have reported the increased risk of the incidence of SGA and preterm birth with increased age in first-time pregnant women (21).

Results of the present study showed a significant relationship between maternal age and IUGR (p=0.026), but no significant relationship between gestational age and IUGR (p=0.185). These findings about maternal age and IUGR are consistent with previous studies (19-21). Research has shown that the relative frequency of SGA in newborns of mothers with a history of hypertension is significantly higher than in newborns of those with normal blood pressure (22). Studies have also reported that Doppler velocimetry of the uterine artery helps in detection of IUGR and pregnancy complications (23). Moreover, the prevalence of SGA in chronic hypertension has been shown to be 10.7% and 23% in proteinuria combined with chronic hypertension (24). Findings show that uterine artery Doppler ultrasound is a gold standard in detection of preeclampsia in high-risk pregnancies (25). Researchers have found that unusual velocity of uterine arteries and fetal MCA artery leads to an increased risk of cesarean section and that increased pulsatility in uterine arteries Doppler is an indication of uteroplacental vascular insufficiency. They have also noted that uterine artery Doppler can be successfully used during pregnancy to evaluate the state of SGA incidence (26). Researchers have reported that increased uterine artery resistance is significantly related to the risk of SGA incidence (27).

There is a significant difference in uterine artery Doppler systolic-diastolic pressure ratio with the highest level observed in EFW<5th percentile which shows a statistically significant difference with other groups (p<0.01). There was also a significant difference among the four groups in terms of UARI with the highest and lowest levels in the <5th percentile and >90th percentile groups respectively, showing a statistically significant difference with other groups (p<0.01). These findings are consistent with previous studies and uterine artery Doppler systolic-diastolic pressure ratio and UARI can be employed to assess the risk of developing SGA during pregnancy (22-27). The incidence rate of SGA in women with oligohydramnios is significantly higher than in women with normal AFI (28). Fetal blood flow recirculation due to decreased uteroplacental perfusion leads to deviation of blood from the kidneys and causes reduction in fetal urine production and ultimately reduces AFI (29).

As such, severe AFI reduction or oligohydramnios can be effective in detecting SGA (27). A study on 175 newborn infants showed that AFI level was significantly lower in SGA cases (30). Amniotic fluid index was the lowest in 5-10th percentile and <5th percentile groups, and the two 10-90th percentile and >90th percentile groups had a significant difference (p<0.01). These findings are in

line with previous studies indicating that amniotic fluid index can be used to predict the incidence of SGA (28-30). Researchers have shown that placental size is 24% smaller in SGA newborns than in normal fetuses and that SGA newborns have smaller placenta than normal newborns and that fetal growth depends of placental weight (31). Another study showed that in cases of SGA, placental thickness went through changes which were not significantly different from normal groups (32). In a study on 18-24-year-old patients placental thickness in SGA pregnancies was shown to be significantly smaller than in normal pregnancies (33). Findings of yet another research showed that placental thickness was significantly smaller in SGA fetuses than in normal fetuses (34). Placental thickness had a non-normal distribution and based on the Kruskal-Wallis test, it was significantly smaller in the $<5^{th}$ percentile group than in other groups (p=0.00), but the difference between $5\text{-}10^{th}$ percentile and $>10^{th}$ percentile groups was not significant (p=0.16). These results are consistent with previous studies and indicate smaller thickness in EFW$<5^{th}$ percentile group (31-34). The present results also showed that there is a significant relationship between placental type and IUGR and also between umbilical cord location and IUGR. In addition, there was also a significant relationship between IUGR and placental location and placental disorders.

4-1. Study Limitations

There were some limitations that should be addressed. Some health files had insufficient information, also pregnant women referred to different hospitals.

5- CONCLUSION

SGA incidence is significantly related to maternal pregnancy age, artery Doppler systolic-diastolic pressure ratio, UARI, AFI, and placental thickness. The results of the present study show that ultrasound changes can be employed to successfully predict the incidence of SGA.

6- CONFLICT OF INTEREST: None.

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