Original Paper

The Implications of the First Trimester 2d and Volumetric Ultrasound in Pregnancy Outcome

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ABSTRACT: Background. The purpose is to investigate the role of the first trimester ultrasound markers: cown rump lengh (CRL), gestational sac volume (GSV), embryonic volume (EV) and yolk sac volume (YSV) as parameters for outcome. Methods. Observational clinical study that was carried out in the Obstetrics and Gynecology Clinic. The study included a number of 81 unselected patients evaluated from the first trimester. Patients were evaluated in the first trimester by transvaginal ultrasound and followed up during pregnancy. Correlations between the GSV, EV, YSV and CRL was made for assessing outcome. Results. Our study results show that patients with abnormal early ultrasound parameters had a higher incidence of pregnancy complications. Conclusions. An early pregnancy evaluation can be a helpful tool in predicting outcome.

KEYWORDS: *First trimester, ultrasound, outcome.*

Introduction

Different ultrasound parameters and maternal demographic characteristics acquired before 12 weeks of gestation were studied [1,2].

Ultrasound has an essential role in pregnancy monitoring and both 2D and volumetric (3D) ultrasound are efficient methods for an accurate first trimester diagnosis [3].

The first trimester ultrasound can predict an abnormal fetal outcome. Literature shows that different ultrasound markers can be used to diagnose risk pregnancies or fetal anomalies [4,5].

It is feasible to measure the gestational sac volumes [6,7] embryonic volumes [6,8], yolk sac volumes [9] and fetus crown rump length [10] accurately and reliably in the first trimester by means of 3D ultrasound [11].

Studies have investigated the use of first trimester volumetric ultrasound in the prediction of miscarriage [11,12,13,14], IUGR and birth weight [15,16,17,18].

Volumetric ultrasound is more accurate and reliable compared to the conventional ultrasound [19,20,21].

Measurement of the CRL is less reliable before 7 weeks and after 10 weeks of gestation [22].

Materials and Methods

This study is an observational clinical study that was carried out in the Obstetrics and Gynecology Clinic from the Emergency County Hospital of Craiova between 2016-2019 and included a number of 81 unselected patients. All patients signed a written informed consent agreeing to anonymously participate in this study, and the study was approved by the Ethics Committee of the University of Medicine and Pharmacy of Craiova.

The study inclusion criteria were: patients with singleton pregnancy. The patients were questioned about their medical history. We noted the date of last menstrual period (LMP), parity and other medical history such as smoking or drug usage.

The patients were scanned using a transvaginal probe by an experienced sonographer and the presence of the ultrasound markers were noted. The obtained markers were measured using the VOCAL method. This is a multiplanar method used to acquire sequential plans of the embryo, gestational sac and yolk sac by rotating around its axis. According to the rotation angle established by the observer the displayed plans can be variable in number [23].

In our study we used a 30-degree rotation angle.

We measured the embryo volume directly [23,24] by drawing a contour line along its head and trunk excluding the limbs [25].

The GSV and the yolk sac volume were also calculated using the VOCAL method [9,11].

The data were collected on an Excel sheet and analyzed. Scatter graphs were generated to evaluate the correlation between the collected parameters. A correlation of these ultrasound

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parameters and pregnancy outcome was made utilizing the Pearson correlation coefficient, in all cases significance was considered for $p<0.05$.

Results

81 patients were evaluated during the first trimester. The median maternal age was 30 years (ranged between 23 and 44 years). 30 patients were nulliparous and 51 patients were multiparous. 38 patients (46,9%) had a previous birth over 37 weeks of gestation and 19 patients had a previous birth less than 37 weeks (23,5%).

21 patients (25,9%) had a previous vaginal birth and 26 patients (32.1%) had a previous cesarean section.

The mean gestational age according to the CRL was 12 weeks+2 days (ranged between 11w+2d and 13w+1d).

The mean gestational age according to the GSD was 12w+2d (ranged from 9w+6 and 14w+6d).

From the patients medical history, 5 patients (6.2%) had a previous intrauterine fetal death, 7 patients (8.6%) had an intrauterine growth restricted fetus, 13 patients (16%) were diagnosed with preeclampsia, 5 patients (6.2%) have developed gestational diabetes.

Our study results show a first trimester abortion in 10 cases (12.3%) and in 2 cases (2.5%) in the second trimester. 20 cases (24.7%) were diagnosed with intrauterine growth restriction.

By means of CRL, the gestational age in the aborted cases is shown in Table 1.

Table 1. Gestational age by CRL in the aborted cases.

		5.1-6.5 weeks (CRL)	6.6-7.5 weeks (CRL)	7.6-8.5 weeks (CRL)	8.6-9.5 weeks (CRL)	9.6-10.5 weeks (CRL)
N	Valid	12	12	11	10	7
	Missing	0	0	1	2	5
Mean		5.983	6.950	7.700	8.380	9.614
Median		6.100	7.050	7.800	8.300	9.500
Std. Deviation		7107	6142	6000	6697	8255
Minimum		5.0	6.1	6.4	7.3	8.3
Maximum		7.6	8.4	8.6	9.3	10.5

No statistical correlation between the EV and pregnancy outcome was found at this gestational age (p=0.612-Table 2).

At 12 weeks of gestation, the CRL has a low correlation (r=0.279, p=0.020) with the fetal birth weight (Figure 1).

There are no statistical differences regarding outcome (p=0.085) (Table 3).

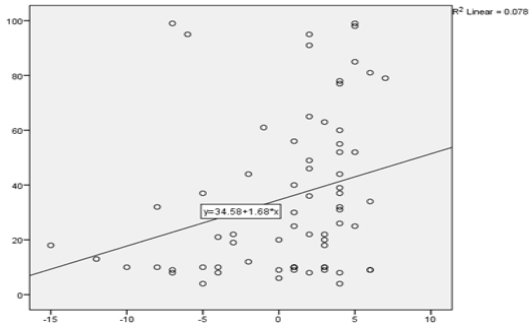

Figure 1. CRL and fetal birth weight correlation.

Table 2. Correlations between EV and pregnancy outcome.

			Pregnancy outcome		Total
			TI/TII abortion	Birth	
11.6-12.5 weeks EV 13-29_N	<5p	Count	1	13	14
		% within 11.6-12.5 weeks_EV_mm3 13-29_B	7.1%	92.9%	100.0%
	>95p	Count	0	1	1
		% within 11.6-12.5 weeks_EV_mm3 13-29 B	0.0%	100.0%	100.0%
	N	Count	1	55	56
		% within 11.6-12.5 weeks EV_mm3 13-29_B	1.8%	98.2%	100.0%
Total		Count	2	69	71
		% within 11.6-12.5 weeks_EV_mm3 13-29 B	2.8%	97.2%	100.0%

Table 3. CRL and outcome correlation.

			Pregnancy outcome		Total
			TI/TII abortion	Birth	
11.6-12.5 (CRL)	-6d and-2d	Count	2	19	21
		% within 11.6-12.5	9.5%	90.5%	100.0%
	-1d and+6d	Count	0	50	50
		% within 11.6-12.5	0.0%	100.0%	100.0%
Total		Count	2	69	71
		% within 11.6-12.5	2.8%	97.2%	100.0%

There are no statistical differences between the fetal CRL and fetal growth restriction at term (p=0.480-Table 4) or an unfavorable pregnancy outcome (p=0.278-Table 5).

Table 4. Fetal CRL and IUGR correlations.

			IUGR		Total
			NO	YES	
11.6_12.5 (CRL)	-6d and-2d	Count	15	4	19
		% within 11.6-12.5	78.9%	21.1%	100.0%
	-1d and+6d	Count	43	7	50
		% within 11.6-12.5	86.0%	14.0%	100.0%
Total		Count	58	11	69
		% within 11.6-12.5	84.1%	15.9%	100.0%

Table 5. Fetal CRL and unfavorable pregnancy outcome correlations.

			Unfavorable pregnancy outcome		Total
			NO	YES	
11.6_12.5	-6d and-2d	Count	6	13	19
		% within 11.6_12.5	31.6%	68.4%	100.0%
	-1d and+6d	Count	23	27	50
		% within tip 11.6_12.5	46.0%	54.0%	100.0%
Total		Count	29	40	69
		% within 11.6_12.5	42.0%	58.0%	100.0%

There are no statistical differences between the GSV and pregnancy outcome (p=0.612-Table 6) or an unfavorable pregnancy outcome (p=0.421-Table 7).

There are no statistical differences between the YSV and pregnancy outcome (p=0.994-Table 8) or an unfavorable pregnancy outcome (p=0.546-Table 9).

Table 6. GSV and pregnancy outcome correlations.

			Pregnancy outcome		Total
			TI/TII abortion	Birth	
11.6-12.5_ weeks_GSV_mm3 75.2-144.1_N	>95p	Count	0	1	1
		% within 11.6-12.5_weeks 75.2 144.1_N	0.0%	100.0%	100.0%
	<5p	Count	1	1	2
		% within 11.6-12.5_weeks_GSV 75.2-144.1_N	50.0%	50.0%	100.0%
	>95p	Count	0	20	20
		% within 11.6-12.5_weeks_GSV 75.2-144.1_N	0.0%	100.0%	100.0%
	N	Count	1	47	48
		% within 11.6-12.5_weeks_GSV 75.2-144.1_N	2.1%	97.9%	100.0%
Total		Count	2	69	71
		% within 11.6-12.5_weeks_GSV 75.2-144.1_N	2.8%	97.2%	100.0%

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Table 7. GSV and unfavorable pregnancy outcome correlations.

			Unfavorable pregnancy outcome		Total
			NO	YES	
11.6-12.5_weeks_GSV 75.2-144.1_N	>95p	Count	0	1	1
		% within 11.6-12.5_weeks_GSV 75.2-144.1_N	0.0%	100.0%	100.0%
	<5p	Count	0	2	2
		% within 11.6-12.5_weeks_GSV 75.2-144.1_N	0.0%	100.0%	100.0%
	>95p	Count	8	12	20
		% within 11.6-12.5_weeks_GSV 75.2-144.1_N	40.0%	60.0%	100.0%
	N	Count	16	32	48
		% within 11.6-12.5_weeks_GSV 75.2-144.1_N	33.3%	66.7%	100.0%
Total		Count	24	47	71
		% within 11.6-12.5_weeks_GSV 75.2-144.1_N	33.8%	66.2%	100.0%

Table 8. YSV and pregnancy outcome correlations.

			Pregnancy outcome		Total
			TI/TII abortion	Birth	
11.6-12.5_weeks_YSV_mm3 0.05-0.250_N	>95p	Count	0	2	2
		% within 11.6-12.5_weeks_YSV 0.05-0.250_N	0.0%	100.0%	100.0%
	N	Count	2	67	69
		% within 11.6-12.5_weeks_YSV 0.05-0.250_N	2.9%	97.1%	100.0%
Total		Count	2	69	71
		% within 11.6-12.5_weeks_YSV 0.05-0.250_N	2.8%	97.2%	100.0%

Table 9. YSV and unfavorable pregnancy outcome correlations.

			Unfavorable pregnancy outcome		Total
			NO	YES	
11.6-12.5_weeks_YSV 0.05-0.250_N	>95p	Count	0	2	2
		% within 11.6-12.5_weeks_YSV 0.05-0.250_N	0.0%	100.0%	100.0%
	N	Count	29	38	67
		% within 11.6-12.5_weeks_YSV 0.05-0.250_N	43.3%	56.7%	100.0%
Total		Count	29	40	69
		% within 11.6-12.5_weeks_YSV 0.05-0.250_N	42.0%	58.0%	100.0%

Discussion

Studies predicting pregnancy outcome approached to much earlier stages of the pregnancy.

Various ultrasound parameters, such as GSV and YSV [26,27,28] and the relationship between them and the average size of the CRL are used in early pregnancy [29,30].

There are several studies that correlated the first trimester ultrasound volumetric markers with outcome [31,32].

Literature showed that the EV has a good correlation with the fetal birth weight than the GSV or CRL [17].

Our study results showed no statistical correlation (p=0.612) between the EV and pregnancy outcome in the first trimester. Also, at 12 weeks of gestation, the CRL had a low correlation (r=0.279, p=0.020) with the fetal birth weight. There were also no statistical differences (p=0.480) between the fetal CRL and fetal growth restriction at term or fetal outcome.

In the first trimester, the GS consists of amniotic and celomic cavity and it reflects the embryonic development environment. GSV measurements can help to distinguish between normal and abnormal pregnancies. Steiner et al. described a strong correlation between the gestational age and GSV during the first trimester [33].

Studies made at different gestational ages (5-12 weeks of gestation) [34] concluded that the GSV was smaller in the aborted cases [35].

Our study results show that there is no statistical correlation (p=0.421/0.612) between GSV in the first trimester and unfavorable/ pregnancy outcome.

Bagratee et al. conducted a study that showed that first trimester YSV reference intervals increased for up to 10 weeks of gestation, then up to 11 weeks it plateaued and decreased afterwards. They suggested that it was caused by decreased vascularization [36].

According to literature, YS normally increases during the first trimester. A small YS is correlated with an abnormal outcome [37].

In the present study, YS increased with gestational week and was found to be positively associated with the CRL. Our results show that there is no statistical correlation between YSV in the first trimester and unfavorable/pregnancy outcome (p=0.546-0.994).

Conclusions

First-trimester volumetric ultrasound represents an important tool for pregnancy outcome prediction.

3D ultrasound is a useful and reproductible method. In the first trimester, at 12 weeks of gestation, only CRL showed a low correlation (r=0.279, p=0.020) with the fetal birth weight.

Application of this method is feasible in prediction of IUGR, birth weight and other pregnancy complications.

Conflict of interests

None to declare.

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