Original Article

The Significance of a Smaller than Expected Crown–Rump Length Measurement for Predicting the Occurrence of Subsequent Miscarriage in a Viable First Trimester Pregnancy

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ABSTRACT

Background: All women experiencing spontaneous pregnancies are advised to undergo ultrasound (US) dating during the first trimester, including those who have certain menstruation dates. Proper first-trimester growth is irregular and dependent on a combination of fetal and maternal variables. The study aimed to determine the predictive value of smaller than expected crown–rump length (CRL) in the occurrence of subsequent abortion in a viable first-trimester pregnancy, the ultrasound findings of CRL from 6-12 weeks of gestation were compared between pregnancies that resulted in a normal outcome and those that resulted in a spontaneous abortion.

Methods: We included 80 pregnant women at 6-12 weeks of gestation viable intrauterine singelton pregnancy in this prospective cohort study at the Departments of Obstetrics and Gynecology of Zagazig University Hospital and Al-Ahrar teaching hospital. A physical examination and taking the history of the eligible cases who agreed to enroll in the study allowed for a full evaluation. Following this, US was used to ascertain the position of the pregnancy, embryos number, their GA, and their viability.

Results: CRL was distributed as 36.40 ± 11.85 with minimum 4.6 and maximum 68.4. Aborted were 61.3%. Aborted cases significantly associated with shorter CRL and with higher gravidity and lower parity. Significant area under curve with cutoff <35.5 with sensitivity 72.5% and specificity 81.8%.

Conclusions: According to our research, there is a strong chance that a shorter-than-expected CRL will result in a subsequent pregnancy loss. US-based prenatal biometry assessment can yield useful data about fetal growth and miscarriage risk. Thorough clinical evaluation and systematic US tracking could perhaps offer the pregnant woman much-needed assistance and support.

Keywords: Crown–Rump Length Measurement, subsequent miscarriage, first trimester..

INTRODUCTION

A crucial first step in establishing appropriate prenatal care is precise pregnancy dating [1]. In order to determine the gestational age (GA) of the embryo or fetus, Robinson employed a transabdominal static scanner in 1973 [2].

The determination of first-trimester abnormal fetal development has been recommended as a useful tool for predicting both adverse outcome of late pregnancy and miscarriage because fetal crown-rump length (CRL) is often used to determine the GA of healthy pregnancy all through the first trimester with great accuracy because of the widespread

belief that first-trimester development is uniform [3,4].

The terms "miscarriage" and "abortion" are often used interchangeably with one another. Abortion is the medical or surgical termination of a pregnancy. There are a number of different terms used to describe the progression of pregnancy loss. Abortions can be termed as threatening, unavoidable, full, or missing. In the early stages of pregnancy, vaginal bleeding can indicate an at-risk miscarriage, even if a pelvic exam reveals a closed cervical os and transvaginal ultrasound shows a viable fetus [5].

All women experiencing spontaneous pregnancies are advised to undergo ultrasound dating during the first-trimester, including those who have certain menstruation dates. In a typical pregnancy, first trimester growth varies and is impacted by both fetal and maternal variables. Many pregnancies that result in first-trimester miscarriages include evidence of early fetal development limitation. Measurements of the fetus's growth in the first-trimester, both cross-sectional and serial, may be useful in forecasting miscarriage and unfavorable late pregnancy complications [3,6].

The concept that first-trimester viable pregnancy linked to delayed fetal development will eventually result in abortion was investigated in a previous study. The vital diagnostic significance of smaller than predicted CRL was identified as a quick and easy way to anticipate the likelihood of a subsequent abortion [7].

The biggest dimension of an embryo, except the yolk sac and the extremities, is known as the CRL. It serves as the main gauge for determining GA between 6 and 13 weeks. After 13 weeks, assessments of the biparietal diameter, length of femur, and head circumference are more relevant for evaluating fetal growth [8].

There has been a growing knowledge regarding the development and growth of first-trimester pregnancies since the introduction of the ultrasound method in early pregnancy. In first-trimester pregnancies, expected CRL has been reported from 6–13

GA starting from the last menstrual period (LMP). Furthermore, some investigations have demonstrated that a smaller-than-predicted CML in first-trimester pregnancies indicates an imminent loss. The US results of CRL from 6–13 weeks of GA from the LMP were compared between pregnancies that resulted in a spontaneous miscarriage and those that ended in normal delivery in order to ascertain the predictive significance of CRL in very early pregnancy [7].

The present study aimed to diagnose the occurrence of subsequent abortion in cases with a viable first trimester pregnancy by the diagnostic value of smaller than expected CRL.

METHODS

Patients:

We included 80 pregnant women at 6-12 weeks of gestation viable intrauterine singelton pregnancy in this prospective cohort study at the Departments of Obstetrics and Gynecology of Zagazig University Hospital and Al-Ahrar teaching hospital in the duration from May 2022 to June 2023. Verbal and written informed consent was obtained from all participants after an explanation of the procedure and medical research. The research was conducted under the World Medical Association's Code of Ethics (Helsinki Declaration) for human research. This study was carried out after the approval of the Institutional Review Board (IRB) (#9431/5-4-2022).

Cases with the following criteria were included; Woman in childbearing age (18-40), spontaneous conception, pregnant woman at 6-12 weeks of gestation (1st trimester), reliable menstrual dates, and viable intrauterine singelton pregnancy.

Cases with the following characteristics were excluded; extrauterine pregnancy, uterine anomalies, multifetal, non-viable pregnancy, conception after assisted reproductive techniques, molar pregnancy, and uncertain LMP.

Methods:

A physical examination and taking the history of the eligible cases who agreed to enroll in the study allowed for a full evaluation.

Following this, US was used to ascertain the position of the pregnancy, embryos number, their GA, and their viability. The same operator (mindrayDC-70Exp) will do all US examinations; the embryo was horizontal on the screen when the midline sagittal section of the entire embryo is measured to determine the embryonic CRL. Every aspect of the mother, including her menstrual and obstetric history, was documented. The major outcome assessment was the percentage of pregnancies with antecedent growth retardation that aborted at the first-trimester end. Follow up until second trimester to evaluate occurrence of miscarriage was done.

Statistical Analysis:
The statistical analysis was performed using IIBM SPSS 20.0. (IBM Corporation, Armonk, New York). Mean and standard deviation were used to characterize quantitative data, whereas numbers and percentages were used to characterize qualitative data. To compare two groups of normally distributed variables, the t-test was used. When applicable, the Chi-square test was employed to compare percentages of categorical variables. The ROC curve was utilized in the diagnosis of a health condition to determine the optimal cutoff for a certain quantitative parameter.

RESULTS
Age was distributed as 26.20 ± 4.83 with minimum 18 and maximum 35. GA was distributed as 11.27 ± 1.68 and GA by US was 10.32 ± 1.82, major gravidity was ≥3 with 55.0% and major parity was 1-2 with 51.3% and 52.5% had history of abortion. CRL was distributed as 36.40 ± 11.85 with minimum 4.6 and maximum 68.4 (Table 1).
Regarding the outcome, aborted cases were 61.3%, while non-aborted cases were 38.8% (Table 2).
There were statistical significant differences between CRL , Gravidity , Parity and abortion history. Aborted cases were significantly associated with shorter CRL and with higher gravidity and lower parity ($P<0.05$) (Table 3). The significant area under curve with cutoff <35.5 with sensitivity 72.5% and specificity 81.8% (Table 4, and Figure 1).
Figure 2: showing 3 cases (A): showing CRL of 28.33 mm 9w +4 d by US And 11 weels by lmp after follow up aborted after 2 weeks, (B): CRL of 28.8 mm 9 weeks +5 days by US and 11weeks 3days by lmp, who returned after 5 days with spotting and pain, (C): CRL of 28.3 mm, 9 weeks +4 days by US with the same GA, aborted after 10 days.

Table 1: Age and obstetric history distribution among studied group

Age	Mean± SD	26.20±4.83	
	Median (Range)	26.0 (18-35)	
GA	Mean± SD	11.27±1.68	
	Median (Range)	12.0 (7-14)	
GA BY US	Mean± SD	10.32±1.82	
	Median (Range)	11.0 (6-13)	
CRL	Mean	36.40±11.85	
	Median	38.4 (4.6-68.4)	
		N	**%**
Gravidity	PG	24	30.0
	1-2	12	15.0
	≥3	44	55.0
Parity	PG	30	37.5
	1-2	41	51.3
	≥3	9	11.3
Abortion	NO	38	47.5
	1.00	31	38.8
	2.00	6	7.5
	3.00	**5**	**6.3**

Table 2: Outcome distribution among studied group

		N	%
Outcome	Aborted	49	61.3
	Not aborted	31	38.8
	Total	80	100.0

Table 3: The relation of obstetric data with outcome

			No abortion	Aborted	t/ X²	P
AGE			26.25±5.25	26.16±4.60	0.085	0.933
GA			11.0±1.80	11.44±1.59	1.165	0.248
CRL			43.56±10.10	31.63±8.24	5.773	0.00**
GA_US			10.29±2.01	10.34±1.71	0.134	0.894
Gravidity	PG	N	14	10		
		%	45.2%	20.4%		
	1-2	N	0	12	13.87	0.008*
		%	0.0%	24.5%		
	≥3	N	17	27		
		%	54.8%	55.1%		
Parity	PG	N	14	16		
		%	45.2%	32.7%		
	1-2	N	8	33		
		%	25.8%	67.4%	21.74	0.00**
	≥3	N	9	0		
		%	29.0%	0.0%		
Abortion history	No	N	19	19		
		%	61.3%	38.8%		
	1.00	N	12	19		
		%	38.7%	38.8%		
	2.00	N	0	6	8.98	0.029*
		%	0.0%	12.2%		
	3.00	N	0	5		
		%	0.0%	10.2%		
Total		N	31	49		
		%	100.0%	100.0%		

Table 4: AUC, cutoff and validity

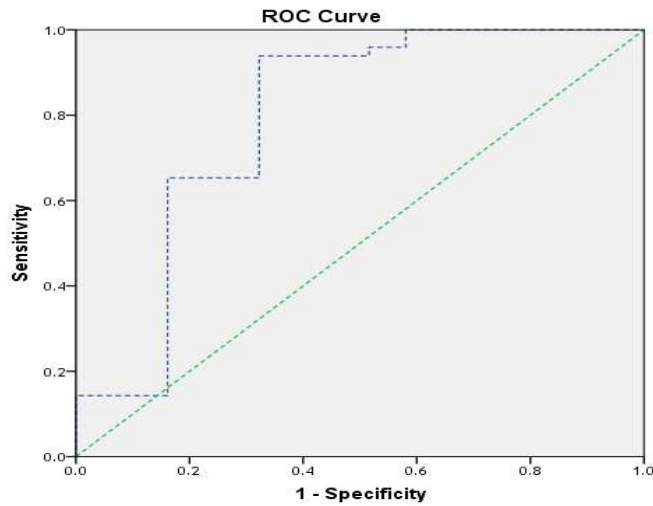| Area	Cutoff	P	Validity	
			Sensitivity	**Specificity**
0.791	<35.5	0.00**	72.5%	81.8%

Figure 1: Area under curve, cutoff and validity of smaller than expected crown–rump length (CRL) in the occurrence of subsequent abortion
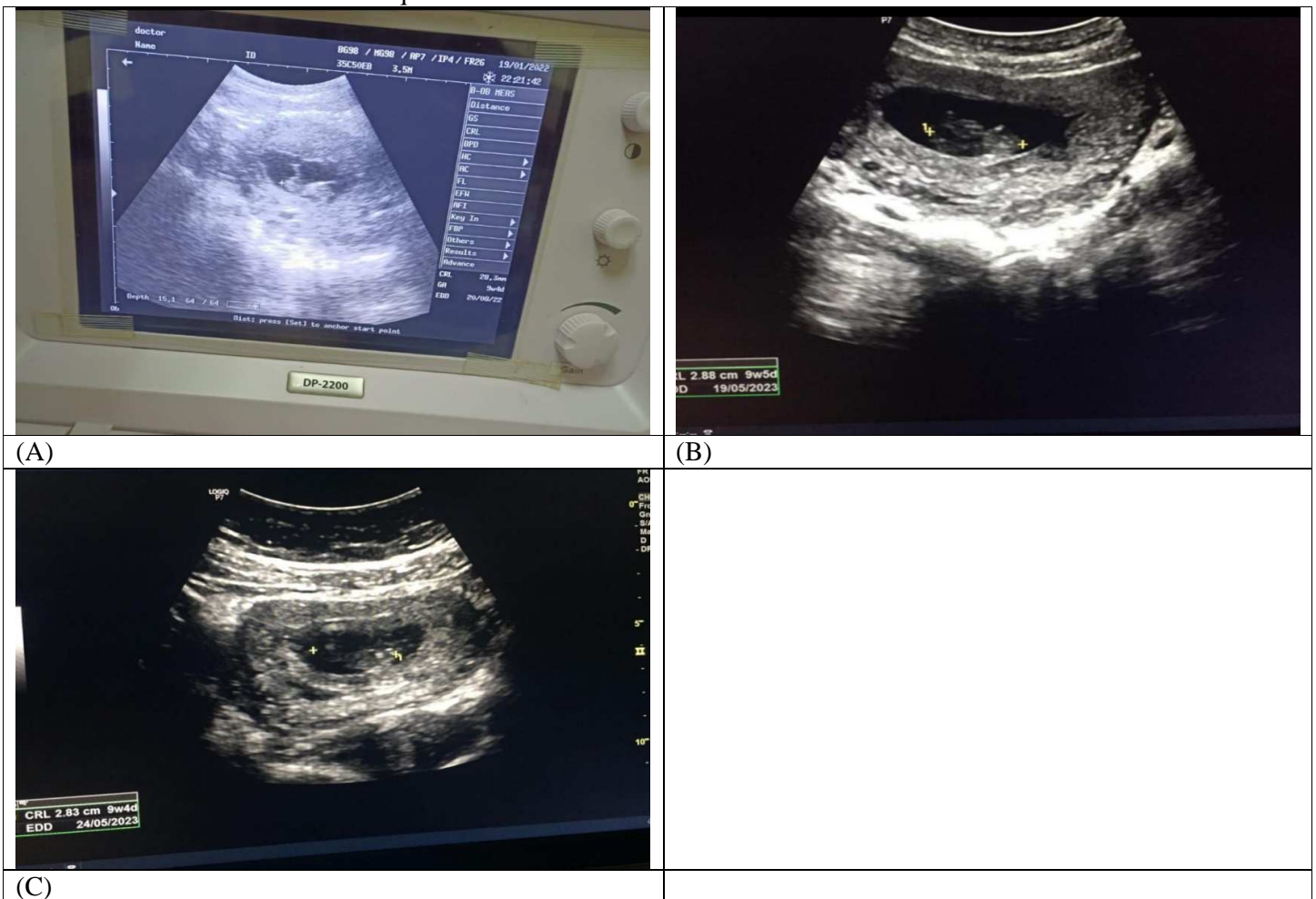

(A)

(B)

(C)

Figure 2: (A): showing CRL of 28.33 mm 9w +4 d by US And 11 weels by lmp after follow up aborted after 2 weeks, (B): CRL of 28.8 mm 9 weeks +5 days by US and 11weeks 3days by lmp, who returned after 5 days with spotting and pain, (C): CRL of 28.3 mm, 9 weeks +4 days by US with the same GA, aborted after 10 days.

DISCUSSION

Fetal growth delay can be detected in the first trimester by either a cross-sectional method or a serial study of fetal biometry. For the cross-sectional approach to determine predicted fetal size for gestation, an accurate memory of MP and a normal menstrual cycle are required. Although time-consuming, serial evaluation of fetal biometry to detect early development delay has been shown to more accurately predict miscarriage than a single CRL measurement of more than 2 SD below that expected [9]. Additionally, CRL evaluation is clinically utilized to forecast unfavorable pregnancy outcomes, such as the probability of threatening abortion or early-pregnancy spontaneous miscarriage [10].

When the CRL falls behind the expected GA by the expected menstruation date, it can serve as a helpful signal to avert several common first-trimester interventions, such as the practical use of progestational drugs in women at risk of miscarriage, conducting cervical cerclage in cases who have cervical incompetence, and re-dating pregnancy corresponding to the evaluated US CRL unless the subsequent serial US evaluations affirm the adequate fetal growth presence [7].

It was hypothesized that if a pregnancy is viable in the first trimester but the fetus is growing slowly, the pregnancy will end in a miscarriage [11]. The purpose of this research was to examine this theory and to determine whether or not a CRL that is less than expected is a useful diagnostic tool for predicting the likelihood of a subsequent miscarriage.

This study was Prospective Cohort study. carried out at the Department of Obstetrics and Gynecology, at Zagazig University Hospital and Al-Ahrar teaching hospital. the study included 80 Pregnant women at 6-12 weeks of gestation viable intrauterine singleton pregnancy.

In the present study, 80 patients were included in the study. age of studied group was 26.20±4.83 with minimum 18 and maximum 35.GA of studies group was distributed as 11.27±1.68 and GA by US was 10.32±1.82, major Gravidity was ≥3 with 55.0% and major parity was 1-2 with 51.3% and 52.5% had history of abortion. CRL was distributed as 36.40±11.85 with minimum 4.6 and maximum 68.4. Aborted cases significantly associated with shorter CRL and with higher gravidity and lower parity. the cutoff <35.5 with sensitivity 72.5% and specificity 81.8%.

In the present study, age of studied group was 26.20±4.83 with minimum 18 and maximum 35.

This was in agreement with Abdel Wahab et al. [12] who reported that patients in the study group (RM group) had a mean age of 28.6 ± 4.6 years, and 13.8% of women had a history of three or more miscarriages, with a mean of 4.6 ± 1.4 miscarriages overall. Also, Frates et al. [13] who studied ninety-six patients with a history of recurrent spontaneous abortion were studied to see if blood flow patterns may predict pregnancy outcomes. Participants' ages ranged from 22 to 46 years, and the mean number of miscarriages was 3.9.

In the current study CRL was distributed as 36.40±11.85 with minimum 4.6 and maximum 68.4. Aborted cases were (61.3%) significantly associated with shorter CRL the cutoff value of CRL was <35.5mm with sensitivity 72.5% and specificity 81.8%.

An important correlation between CRL size and the risk of miscarriage was also discovered in a recent study from Bangladesh, supporting these results, CRL was found to be an important predictor of prenatal growth and neonatal outcome [14]. Similarly, Varelas et al. [15] found that a high risk of foetal loss was linked to a short CRL

Contrary to the findings of Falco et al. [16], who compared the sonographic findings of women who prolonged their pregnancies despite an abortion threat to those of women who went through with an abortion, this study found no correlation between the two. Abortions were 23 out of every 149. (15 percent).

Reference values for the 10th through the 90th percentiles were derived from 227 IVF pregnancies, and Aziz et al. [17] compared the CRL measured at 6-9 weeks' gestation in 837 spontaneous abortions to these values. Fetal loss was more likely when CRL was less

than the 50th percentile during the week of pregnancy (19.4 vs. 3.3 percent). Laing et al. [18] and Varelas et al. [15]. also identified a correlation between the two, but they narrowed their attention to groups of people who showed signs of having an abortion.

The only study to date that used gestational age to predict early foetal demise was conducted by Adiga et al. [19] During the first trimester, sonographic measurements such as the mean sac diameter, CRL, gestational age at first ultrasound, and cardiac activity were taken and combined with the mother's age. However, Doubilet et al. [8] in a prospective analysis of 99 pregnancies, were unable to show this correlation, most likely due to the small sample size.

The LMP is based on the assumption that ovulation occurs on day 14 in women who conceive biologically. As a result, the smaller-than-expected CRL may just reflect a delayed conception in proportion to the LMP rather than an actual fetal growth delay, which could introduce an element of bias into the analysis [20]. This is why we based our sample on women who had regular menstrual cycles and adjusted the LMP date accordingly. Women who have used assisted reproductive technology make a good study population since the conception date may be pinpointed with precision [21].

Multiple hospital-based studies have found that a low CRL early in pregnancy is an excellent predictor of a miscarriage [22]. It follows that a lower CRL relative to the gestational age of the fetus is an important predictor of miscarriage.

The present study's strongest point was that it revealed the value of assessing CRL as a quick, easy way to predict future miscarriages. This study has limitations, since just one tertiary care hospital was used in the study and a small sample size was used, results could not be applied to the entire community. Second, the study excluded a number of potential causes of early abortion, including an abortion history, vaginal hemorrhage, gestational diabetes, and hypertension. Thirdly, in order to improve the predicted accuracy of CRL, we did not combine it with additional parameters.

CONCLUSIONS

According to our research, there is a strong chance that a shorter-than-expected CRL will result in a subsequent pregnancy loss. US-based prenatal biometry assessment can yield useful data about fetal growth and miscarriage risk. Thorough clinical evaluation and systematic US tracking could perhaps offer the pregnant woman much-needed assistance and support.

CONFLICT OF INTEREST: No potential conflict of interest was reported by the authors.

FINANCIAL DISCLOSURE:None

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