

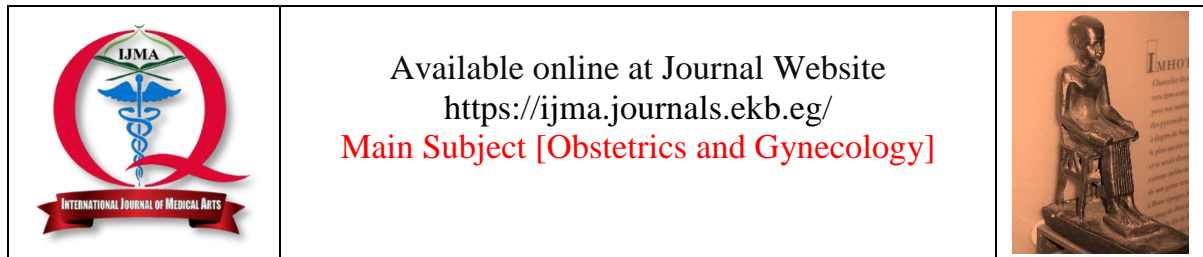
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Original Article

Comparative Study between Crown-Rump Length and Fetal Volume in First Trimester for Accurate Estimation of Gestational Age

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ABSTRACT

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Background: A fetal ultrasound [US] scan during the first trimester of pregnancy is essential for confirming fetal viability, estimating the fetus' gestational age [GA], and identifying fetal anomalies. US pictures taken in the first trimester of pregnancy seem different from those taken in the second trimester because of the distinct developmental stage of the fetus.

Aim of the Study: To compare between 2D US and 3D US with regard to CRL and E/FV in an accurate estimation of GA in the first trimester.

Patients and Methods: This prospective research was done on 48 cases of singleton live pregnancies at 7–11 weeks' gestation in the department of Obstetrics and Gynecology, Al-Azhar University Hospital [New Damietta] from January 2021 to January 2022.

Results: There was a significant positive association between embryonic volume and embryonic CRL in the 8th, 9th, 10th, and 11th weeks. However, there was no significant correlation in the seventh week. This means that the calculated gestational weeks by CRL and VOCAL are close to those detected by LNMP. The diagnostic accuracy of CRL in the detection of fetal age was higher than the accuracy of VOCAL in the detection of fetal age as compared to LNMP.

Conclusion: The use of E/FV for GA determination is nearly as accurate as CRL, despite the fact that it is less complicated and relies on 2D rather than the more expensive and complex 3D US. EV/FV is a good predictor of GA and new, promising technology.

Keywords: Crown-Rump Length; Fetal Volume; Gestational Age; First Trimester.



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INTRODUCTION

Over the past decade, the focus of prenatal screening has expanded from early detection of aneuploidy to include detection of other potential problems with the pregnancy, such as short for gestational age [SGA] later on in pregnancy [1].

The ability to accurately estimate GA at the individual level is crucial throughout pregnancy for a number of reasons, including the ability to correctly assess fetal anatomy and growth patterns, calculate an expected delivery date, and evaluate a newborn's degree of maturity. Accurately estimating the rates of SGA fetuses and preterm births at the population level is crucial for allocating resources effectively [2].

Traditional GA calculations have used the first day of the last normal menstrual period [LNMP] as the starting point. Nevertheless, the LNMP is either unknown or the information is incorrect for a certain percentage of pregnancies, and this percentage varies by region. At <14 weeks and ≥ 14 weeks of pregnancy, respectively, GA can be measured using US assessment of fetal crown-rump length [CRL] or head circumference. A reliable estimate of GA may be made between 7 and 11 weeks of gestation since linear development, as measured by CRL, is fast at this time and the SD is very small [3].

Changing the location of the embryo or fetus even slightly can have a significant impact on the CRL results. Some writers have suggested taking three separate CRL readings and averaging the results; this might be a time-consuming approach. Another problem is that CRL focuses on just one aspect of the fetus. In order to evaluate fetal growth, it is necessary to take into account the fetus's volume because it is basically a three-dimensional [3D] object [4].

It is more accurate to utilize 3D US to determine the volume of an irregularly shaped item by tracing its surface than by utilizing mathematical formulas [5]. Calculated by computerized volume As US is a relatively new and promising technique, we are optimistic that it will allow us to obtain further volumetric measurements of ovarian follicles and fetal features. There might be significant effects on clinical practice from using volumetric metrics [6].

This research aimed to contrast 2D US and 3D US with regard to CRL and E/FV in the accurate estimation of GA in the first trimester.

PATIENTS AND METHODS

This is a randomized single-blinded controlled trial This prospective research was done on 48 cases of singleton live pregnancies at 7–11 weeks' gestation in the department of Obstetrics and Gynecology at Al-Azhar University Hospital [New Damietta] and women who have had regular menstrual cycles in the past and had a healthy, uncomplicated pregnancy were also involved .From January 1, 2021 to January 31, 2022. Al-Azhar University Hospital [New Damietta]

Inclusion Criteria: Women carrying a singleton infant during the first trimester of pregnancy [weeks 7–11], in the state of uncomplicated pregnancies and women who know the exact day they last ovulated due to a lifetime of regular monthly cycles

Exclusion Criteria: History of recurrent abortions, presence of fetal anomalies, and history of chronic diseases such as HTN, DM, and SLE

Ethical Considerations: Consent of the administrators of the healthcare facility, given after adequate education. Consent to participate in the study was obtained verbally from each individual who took part in the investigation. At every stage of the investigation, confidentiality was maintained, and individual participants' right to privacy was observed. The information that was collected was not utilized for any other purpose.

Data collection: History taking and US examinations [measurement of CRL and measurement of E/FV]



Figure [1]: CRL measures about 1.93 cm corresponding to age about 8w3d



Figure [2]: CRL measures about 3.47 cm corresponding to age about 10w2d



Figure [3]: 3D multiplanar view of fetus having volume of 1.059 cm³



Figure [4]: 3D multiplanar view of fetus having volume 3.145 cm³

Sample size

The sample size was estimated using the G*Power program [7]. Previous research stated that the mean of embryonic volume was 1.7 and $SD \pm 1.2$ [8]. With an absolute precision of 5%, an alpha error of ± 0.05 and a study power of 0.80, the sample size will be at least 48.

Statistical analysis

The Statistical Package for Social Science [SPSS] for Windows [version 26] was utilized to do the analysis on the data that was collected. An initial one-sample Kolmogorov-Smirnov test was carried out in order to examine the normality of the data. The qualitative data were characterized by the use of numbers and percentages. When presenting normally distributed data, the mean and standard deviation of continuous variables were used. For the purpose of correlating continuous variables, Pearson correlation was utilized. The p-value that was obtained should be as low as possible for the results to be considered significant.

RESULTS

The commonest age group was [20–30 years, 75%], followed by [>30 years, 14.6%], then [≤ 20 years, 10.4%] [Table 1].

Most of our patients were at 9th weeks [29.2%] followed by 11th weeks [25%] then 8th weeks [20.8%] and the least group were at 7th and 10th weeks [12.5%] [Table 2].

According to LNMP at 7th, 9th, and 11th gestational weeks, the number of fetuses detected by CRL was higher than that detected by VOCAL. On the other hand, at 8th and 10th weeks, it is the reverse [Table 3].

There was a significant positive association between embryonic volume and embryonic CRL in the 8th, 9th, 10th, and 11th weeks [p value ≤ 0.001 , which was <0.05]. But there was a non-significant correlation in the 7th week [p value 0.628, which was >0.05] [Table 4]. There was a strong positive correlation between fetal age detection by both CRL and VOCAL and that was detected by LNMP. There was no statistically significant variance concerning fetal age detected by CRL and that was detected by LNMP and also there was no statistically significant variance concerning fetal age detected by VOCAL and that is detected by LNMP. This means that the calculated gestational weeks by CRL and VOCAL are close to those detected by LNMP [Table 5].

Diagnostic accuracy of CRL in detection of fetal age was [85.4%] which is higher than accuracy of VOCAL in detection of fetal age as compared to LNMP which is [72.9] [Table 6].

Table [1]: Age distribution among the studied group

Age distribution		The study groups [n=48]
Age [years]	Mean \pm SD Min-Max	25.81 \pm 4.44 17-38
Age classes	\leq 20 y 20-30 y > 30 y	5 [10.4%] 36 [75.0%] 7 [14.6%]

Table [2]: GA by weeks depending on LNMP in this study

Gestational weeks	Fetal age LNMP	
	No	%
7 th week	6	12.5
8 th week	10	20.8
9 th week	14	29.2
10 th week	6	12.5
11 th week	12	25.0

Table [3]: Embryo/Fetal age as detected by CRL & VOCAL

Gestational weeks	Number of Fetus by CRL	Number of Fetus by VOCAL
7 th week	4 [8.3%]	3 [6.2%]
8 th week	13 [27.1%]	15 [31.2%]
9 th week	12 [25.0%]	9 [18.8%]
10 th week	6 [12.5%]	11 [22.9%]
11 th week	13 [27.1%]	10 [20.8%]

Table [4]: Correlation between CRL and VOCAL at different gestational weeks

Gestational weeks	r	P value
7 th week	0.254	0.628
8 th week	0.943	\leq 0.001*
9 th week	0.868	\leq 0.001*
10 th week	0.909	\leq 0.001*
11 th week	0.900	\leq 0.001*

Table [5]: Correlation between GA by CRL, VOCAL and LNMP

	Gestational age by LNMP	
	r	P value
Gestational weeks by CRL	0.919	\leq 0.001*
Gestational weeks by VOCAL	0.867	\leq 0.001*

Table [6]: Diagnostic accuracy of detecting fetal age by CRL & VOCAL as compared to LNMP

Accuracy	Fetal age CRL	Fetal age VOCAL
Sensitivity	89.2%	75.7%
Specificity	72.7%	66.7%
PPV	91.7%	83.3%
NPV	66.7%	55.6%
Accuracy	85.4%	72.9%

DISCUSSION

In obstetrics, an accurate GA calculation is crucial since it forms the basis for life-or-death choices throughout pregnancy. US is more reliable for estimating GA during the first trimester because there are fewer biological variances among women and the increases in US parameters are more stable during this time [9].

Some research suggests that even little shifts in fetal position might impact CRL results. Some writers have suggested taking three separate CRL readings and averaging the results; this might be a time-consuming approach. Another problem is that CRL focuses on just one aspect of the fetus. Considering the fetus's volume while making fetal growth estimates is important since the fetus is a 3D object [10].

This study included 48 pregnant female patients referred for US examination from the obstetrics and gynecology department and its outpatient clinic at Al-Azhar University Hospital of Damietta. Their ages ranged from 17 to 38 years old at the time of diagnosis, with the commonest age group being 20–30 years [75%], followed by >30 years [14.6%], and ≤ 20 years [10.1%].

Depending on LNMP, most of our patients were at 9 weeks [29.2%], followed by 11 weeks [25%], then 8 weeks [20.8%] and the least group were at 7th and 10th weeks [12.5%].

In our study, the number of embryos and fetuses detected by CRL at 7th, 9th, and 11th gestational weeks was higher, according to LNMP, than that detected by VOCAL. On the other hand, at 8th and 10th weeks, it is the reverse.

In the present research, the EV varied from a mean of 0.493 ± 0.068 cm³ [range 0.45 to 0.58 cm³] at 7 weeks to 8.12 ± 3.33 cm³ [range 3.94 to 13.80 cm³] at 11 weeks. A similar trial was done by **Gaafar *et al.*** [8] and **Elfaïomy *et al.*** [4] To assess a reference range for EV, different findings with a narrow range ranged from a mean of 0.42 ± 0.233 to 3.11 ± 0.539 and from 0.20 ± 0.23 cm³ to 5.12 ± 1.57 cm³, respectively. These authors measured EV with a manual outline of different numbers of sequential planes and the latter used the XI vocal technique. This might be the reason for the discrepancy. The evaluation of EV at ages 7–11 weeks was, however, consistent across our various approaches.

In the present research, the embryo/fetus CRL varied from a mean of 1.33 ± 0.11 cm [range 1.20 to 1.43 cm] at 7 weeks to 4.21 ± 0.23 cm [range 3.85 to 4.50 cm]. At 11 weeks, this is in agreement with **Papageorghiou *et al.*** [3] who set out to create the first universal guidelines for measuring embryo/fetal size and pregnancy date in the US using CRL.

This study demonstrated a significant positive association among E/FV and embryonic/fetal CRL in the 8th, 9th, 10th, and 11th weeks [r ranged from 0.868 to 0.943, p value ≤ 0.001], apart from a non-significant positive correlation in the 7th week [r = 0.254, p value 0.628]. This is consistent with the findings concluded by **Gaafar *et al.*** [8] and **Marin *et al.*** [11] who stated that there is a strong association between E/FV estimation and CRL assessment for the forecast

of GA [r = 0.950] and thus EV is a good indicator of GA.

The present study showed high diagnostic accuracy of CRL in estimation of GA as compared to LNMP [85.4%] with specificity [72.7%] and sensitivity [89.2%] and this is in agreement with **Bailey *et al.*** [12] who assess the accuracy of bedside US assessments of CRL by emergency providers [EPs] with varying levels of experience in determining GA in pregnant patients. Also, this is in agreement with **Dias *et al.*** [13] who evaluated it in twin pregnancies.

In the current study, we found that the accuracy of CRL in the estimation of GA between the 7th and 11th weeks is relative higher than the accuracy of VOCAL in the estimation of GA as compared to LNMP and this was in disagreement with **Sur *et al.*** [14] who stated that vocal is more accurate. This may be due to the fact that they applied their study to a larger number of pregnant females after IVF with a more accurate date of LNMP.

We employed the VOCAL method for GA estimation, which has been used with good accuracy for this very purpose before, in the current work. This method was used by **Lee *et al.*** [15] to calculate the volume of the gestational sac at an early stage in the pregnancy, and it showed a bias and agreement with the 2D ellipsoid model measurement that were clinically acceptable. **Tudorache *et al.*** [16] also employed this technique for the determination of placental volume, gestational sac volume, and yolk sac volume in early pregnancy for predicting pregnancy outcomes, comparing it to 2D US with a significant correlation between both but with a higher accuracy of 3D in predicting pregnancy outcomes.

Finally, our results revealed that there is no statistically significant variance concerning fetal age detected by CRL and that is detected by LNMP and there is also no statistically significant variance regarding fetal age detected by VOCAL and that is detected by LNMP. This means that the calculated gestational weeks by CRL and VOCAL are close to those detected by LNMP.

The limitations of this study represented by the sample size were not enough and patients need a longer period of follow-up.

Conclusion: Our study concluded that the use of E/FV for GA determination is nearly as accurate as CRL, despite the fact that it is less complicated and relies on 2D rather than the more expensive and complex 3D US. EV/FV is a good predictor of GA and new, promising technology.

Disclosure: None to be disclosed

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