Original Article

THE DIAGNOSTIC VALUE OF ULTRASOUND MEASUREMENTS IN PREDICTION OF FIRST TRIMESTER MISCARRIAGE

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ABSTRACT

Background: The use of ultrasound in conjunction with serum gestational enzyme levels facilitates the diagnosis, control, and management of early pregnancy loss; however, errors in usage and misinterpretation of these investigations can cause serious harm. An excellent-resolution pictures, minimal inter-observer variability, and excellent reliability are provided by transvaginal and abdominal ultrasonography, which are commonly used to diagnose intrauterine pregnancy and monitor its progression. **Objective:** To estimate a risk of first trimester pregnancy loss based solely on ultrasound findings. The study hypothesis was that different markers would sequentially become abnormal at different embryonal stages, when a pregnancy is destined to be lost. **Methods:** Case series study for 250 pregnant ladies who had been scanned by trans vaginal and trans abdominal ultrasound between (August 2024 to the end of September 2024) in Al Salam Teaching hospital in Mosul city, these (250) ladies had been distributed into three groups: First group comprised 65 women which are expected to end in abortion early, second group comprised 72 ladies have history of threatened abortion in which their pregnancy completed till 13 weeks. Third group comprised 113 ladies that have normal pregnancy. **Results:** The study shows that statistically significant differences between the study groups regarding FHR, CRL, GSD and YSD which were higher in (first & second group), for women end with actual abortion as the mean were 7.22 ± 0.23 mm, 51.73 ± 17.22 mm and 6.91 ± 0.8 mm respectively. If compared to the third group in which CRL, GSD and YSD were 6.89 ± 0.67 mm, 38.24 ± 13.97 mm and 6.89 ± 0.67 mm respectively for women who completed their pregnancy. **Conclusion:** The use of an ultrasound machine to investigate and diagnose early pregnancy failure in conjunction with quantitative beta human chorionic gonadotropin hormone level assessment and progression gives definitive power in diagnosis and management for both normal and abnormal pregnancy outcome.

KEYWORD: Ultrasound, Pregnancy, Miscarriage, Mosul, Iraq.

1- INTRODUCTION

Early pregnancy loss is defined as "a nonviable, intrauterine pregnancy with either an empty gestational sac or a gestational sac containing an embryo or fetus without fetal heart activity prior to 12 weeks and 6 days of gestation ".[1] It is also referred to as pregnancy loss, fetal demise, miscarriage, or spontaneous abortion.[2] It is the most frequent early pregnancy problem, impacting 11.8 % of spontaneously conceived pregnancies and slightly higher for assisted reproduction pregnancies.[3] Actually, vaginal bleeding, which is frequently a symptom of early pregnancy loss, might be mistaken for a delayed menstrual cycle, rendering the loss undetected.[4] Embryonic genetic abnormalities account for about 70% of all first trimester pregnancy losses; aneuploidy is the most common type of abnormality.[5] To detect pregnancy prone for loss, a number of serologic and ultrasonography markers have been studied. Nevertheless, serologic markers are only useful if a pregnancy loss has been identified.[6] An excellent-resolution pictures, minimal inter-observer variability, and excellent reliability are provided by transvaginal and abdominal ultrasonography, which are commonly used to diagnose intrauterine pregnancy and monitor its progression. As shown in Figure 1a and Figure 1b.
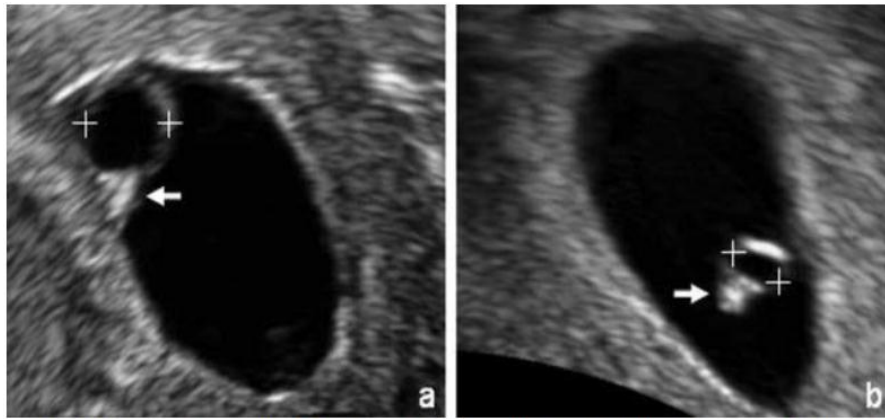
Figure 1a: illustrates abnormal yolk sac measure 7 mm Figure 1 b: illustrates normal yolk sac 2mm

The measurements used to assess early pregnancy include heart rate (HR), crown-rump length (CRL), yolk sac (YS), and gestational sac (GS).[7] An alternate method of predicting first trimester pregnancy loss has involved examining deviations in the ultrasonography measurements.[8] Usually overlooked in prediction models, the amniotic sac aids in dating and becomes apparent at the start of the seventh week of pregnancy.[9] Along with ultrasound capacity to provide precise images of the early gestational sac, it also provides a significant indicator of the epidemiology and pathophysiology for miscarriage and early pregnancy failure.[10-11] The use of ultrasound in conjunction with serum gestational enzyme levels (e.g., progesterone and human chorionic gonadotropin) facilitates the diagnosis, control, and management of early pregnancy loss; however, errors in usage and misinterpretation of these investigations can cause serious harm.[12-14] The aim of the study was to estimate a risk of first trimester pregnancy loss based solely on ultrasound findings. The study hypothesis was that different markers would sequentially become abnormal at different embryonal stages, when a pregnancy is destined to be lost.

2. PATIENTS AND METHODS

This is a case series study for 250 pregnant ladies who had been scanned by trans vaginal and trans abdominal ultrasound between (August 2024 to the end of September 2024) in Al Salam Teaching hospital in Mosul city, the sonographic cut off value for examinations of early pregnancy failure and miscarriage assessed and performed accurately. Maternal characteristics recorded are age, conception method (whether it was spontaneous or assisted one which requiring IVF), taking any medicines (yes or no) and parity. Recording last menstrual period (LMP) date and classified it as a regular cycle (26–30 days) with definite LMP, regular-indefinite, irregular- unknown and conception within three cycles after last pregnancy or stop taking the contraceptive pill indicators of assessment in ultrasound hospital unit. Ladies who were subjected to the current study had gestational age ranging between 5th -13th week which was calculated depending on the last menstrual period, then the pregnancy has been

confirmed using ultrasound diagnosis. The study excluded the cases with multiple gestation that have abortion secondary to cervical incompetence, or who had abortion whether it was inevitable or incomplete abortion, and also excluded the cases with ectopic pregnancy or GTD (Molar pregnancy). All women had been exposed to examine full history, abdominal, and trans vaginal or abdominal ultrasound (3-5 MHZ), measure fetal heart rate (FHR), gestational sac diameter (GSD), Crown-rump length (CRL), Yolk sac diameter and GSD-CRL ratio.

In the beginning, these (250) women had been subjected to the examination of serum level of beta human chorionic Gonadotropin distributed into three groups: First group comprised 65 women assisted with routine ultrasound examination which expected to end in abortion early, second group comprised 72 ladies have history of threatened abortion in which their pregnancy completed till 13 weeks. Third group comprised 113 ladies that have normal pregnancy. Ultrasonic study for these three groups of the participated pregnant women, the ultrasound was conducted regarding the following indicators as follows: 1- Mean gestational sac diameter (MSD): MSD had been measured according to the mean diameters, which is the diameter of the sac was measured longitudinally, transversally, obliquely ignoring the decidual reaction. It is usually inside endometrium, and has a round or oval shape and it is smooth.[15] 2- Yolk sac (YS), it is estimated by putting calipers on the internal walls of the longer diameter. It often exists at peripheral of GS and should not be free from the sac, sac dimension, its morphology, echogenicity of the edge, the sac's center, the number of it, and retrograde modifications, (calcification as example) are observed thoroughly, the diameter of normal Yolk sac ranges between 3-5 mm, its spherical in shape, with no retrograde changes, existence of echogenic edge and hypo echoic center are considered as normal.[16] Any aberration from mention parameters refereed to abnormal signs. 3- Crown-rump length (CRL) it represents the embryo length from the crown (top of the head) to the rump bottom without the yolk sac or extremities[17], to be estimated in sagittal part of the embryo then it is

recorded as three measurements ' mean. 4- The ratio of GSD, to crown-rump length (MGSD-CRL) was calculated for any difference between them, if this difference was less than 5 mm are expected to be miscarriage within first trimester.[18] 5- Embryonic heart rate (FHR) was also calculated at M-mode depending on beat / minute using ultrasound device software. The Collected data had been analyzed depending on the statistical package for social sciences program, (SPSS Inc, U.S.A, version 26.0). Where Quantitative data had been represented as mean ± standard deviation (SD), but Qualitative one had been represented as percentage and

frequencies. As well as, sensitivity, positive predictive values (PPV), negative predictive values (NPV) and specificity have been assessed. If probability value was < 0.05 it considered as statistically significant difference.

3. RESULTS

Table 3.1 shows among 250 ladies that participated in this study which distributed into three categories, there wasn't significant statistical difference between the three study groups in the terms of age, parity, Body mass index, GA, or the number of previous abortions.

Table 3.1: Demographic data of the study groups.

Demographic Data	First group		Second group		Third group		P-value
	Mean	SD	Mean	SD	Mean	SD	
Age	28.7	4.9	29.4	6.6	31.5	6.1	> 0.05
Parity	1.2	0.96	1.3	1.4	1.3	2.3	
Body mass index	28.44	2.6	26.6	2.7	26.6	2.1	
Gestational age	6.3	2.5	7.45	2.1	7.3	2.4	
Previous abortion	1.2	056	0.75	0.56	0.87	0.61	

Table 3.2 shows the ultrasonic parameters; it's evident that FHR (fetal heart rate) and crown rump length CRL showed a statistically difference among control group (third group, n= 113) and first group who aborted before

13 weeks of gestational age (n=65) and second group who suffered from threatened miscarriage but they completed their pregnancy till 13 weeks (n=72).

Table 3.2: Comparison of fetal heart rate and crown rump length of the study groups.

Ultrasound Parameters	First group Aborted		Second group incomplete miscarriage till 13 weeks		Third group control		P value
	Mean	SD	Mean	SD	Mean	SD	
FHR	99.34	±14	163.6	±19.5	161.1	±22.3	<0.005
CRL	7.05	±0.11	7.7	±0.4	8.9	±1.7	

Table 3.3 illustrates that CRL, GSD and YSD were higher significantly in (first & second group), for women end with actual abortion as the mean were 7.22 ± 0.23 mm, 51.73 ± 17.22 mm and 6.91 ± 0.8 mm respectively.

If compared to the third group in which CRL, GSD and YSD were 6.89 ± 0.67 mm, 38.24 ± 13.97 mm and 6.89 ± 0.67 mm respectively for women who completed their pregnancy.

Table 3.3: Comparison of ultrasonic Indicators between First + Second groups (number 137) with third group (number =113).

Ultrasonic Indicators	First and Second groups (Number = 137)		Third group (Number = 113)		P value
	Mean	SD	Mean	SD	
CRL	7.22	± 0.23	8.9	± 1.7	0.12
GSD	51.73	± 17.22	38.24	± 13.97	0.04
YSD	6.91	± 0.8	6.89	± 0.67	0.023

Table 3.4 shows the sensitivity, specificity, PPV and NPV have been calculated for significant predictors at

fetal heart rate (FHR) of 107 bpm, and crown rump length at 8.1 mm ± 0.2 mm.

Table 3.4: Sensitivity, specificity, PPV and NPV of the ultrasonic predictors.

Predictors	Sensitivity	Specificity	Positive predictive value	Negative predictive value
FHR (107) ± beat/ minute	98.1	98.7	90	92
CRL (8.1 mm ± 0.2 mm).	47.7	41.23	33.87	38.04

The study also indicated that the number of actually miscarriage ladies was high among threatened abortion group ending with abortion with percentage (39%) it means 98 women from 250 lost their fetus before 13 weeks of gestational age, followed by second group 15

(6%) who were expected to complete their pregnancy till 13 weeks of GA, while among the third group (healthy pregnancy cases) there was only one case who lost her fetus (0.4%). As shown in figure 2.
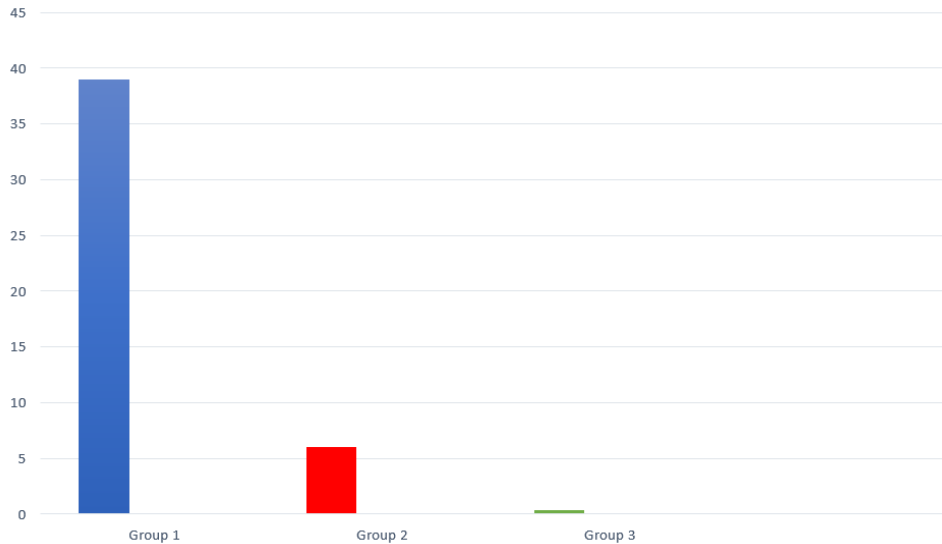
Figure 2: Graph shows the percentage of actual miscarriage for the groups of the study

Regarding to the ratio of GSD mean to crown-rump length (MGSD-CRL), the study results illustrated that during first trimester gestational age univariant analyses showed that higher rates of early pregnancy failure among pregnant ladies with a m GSD-CRL < 5mm, comparing to the reference value m GSD-CRL of 5–9.9 mm (42.9 % vs. 15.6 %, p < 0.0001), as shown in Figure 3.2. Oppositely, miscarriage cases were less prevalent in pregnant ladies with MGSD-CRL 10–14.9 mm (10% versus 15.6 %; P < 0.007) or ≥ 14.9 mm (7 % versus 15.6 %; p<.018) comparing to the reference value of MGSD-CRL of 5–9.99 mm. As shown in figure 3.
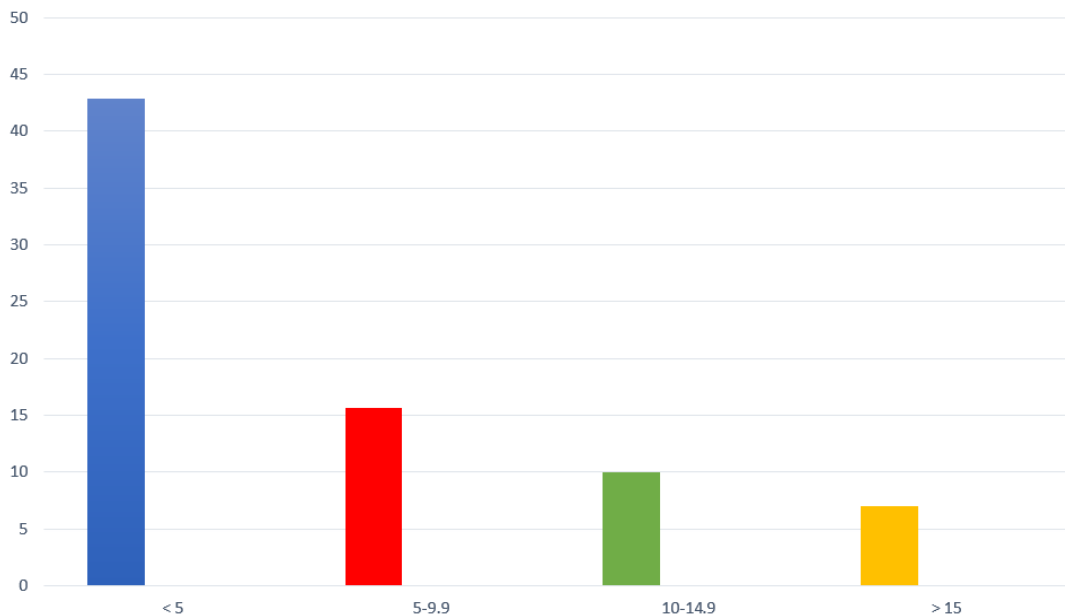

Figure 3: The percentage of number of miscarriages according to measures of MGSD-CRL.

4. DISCUSSION

The study was based on matching groups as a result there was no significant statistically differences among groups of the study regarding characteristics of pregnant women (maternal age, BMI, gestational age and parity). These results agree with Maha M. Hassan et al study results.[19] Additionally; the study illustrates that actual miscarriage was high among threatened abortion group ending with complete abortion in a percentage of 39% while; the second group who were expected to complete their pregnancy till 13 weeks of gestational age where it was 6%, from the other hand; the majority of the third group (healthy pregnancy cases) passed uneventfully 99.1%. These percentages ensure the importance of ultrasound roles for the assessment and follow up of pregnancy & detects early failure. Anyhow; Kavitha D. Nayak et al showed comparable results about percent of threatening abortion ends with complete abortion.[20] FHR, GSD,

YSD, CRL, and MGSD-CRL measurements, with other clinical and biochemical measurements, were able to identify 90% of women who went on to experience a positive miscarriage, demonstrating the importance of the ultrasound in the early detection of miscarriage. Univariate analyses revealed that the first group of pregnant women with mean GSD-CRL ratios < 5mm (42.9%) had higher rates of early pregnancy failure, while the control group had lower rates with mean GSD-CRL ratios ≥ 14.9 (7%), this is consistent with[19] and.[20] The current study also showed that abnormal YSD and abnormal GSD related to the fetal node were more common in the real miscarriage groups, in other word; women who aborted in the first and second groups compared to women who completed their pregnancy in the third group. These findings are consistent with Haitham Torky et al results.[21] FHR and CRL measure assessment scan at early pregnancy can contribute in determining the cases ends with missed abortion specially for those that have history of bleeding and abdominal pain. Moreover; the study shows at FHR of (107 bpm) and CRL of 8.1 mm ± 0.2 mm, the Sensitivity is 98.1%, specificity is 98.7%, PPV is 90 and NPV is 92 of the ultrasonic predictors for pregnancy loss, these results are parallel to Sherif Fathi El-Mekkawi et al findings.[22]

5- CONCLUSION

In summary, the cutoff values for early pregnancy failure and miscarriage are as follows: the presence of the pregnancy sac within the thickened decidual reaction and endometrial cavity with no yolk sac; the sac diameter measured about 8-10 mm by transvaginal ultrasound at 5 weeks gestational age or 20 mm and above at 7 weeks by transabdominal ultrasound with no visible fetal node; the mean sac diameter measured 24 mm +/- 16 mm with no fetal heart in an embryo with CRL 7.05 ± 0.11 or the appearance of an empty sac sign with thickened chorionic reflections. In addition to providing a definitively accurate pregnancy follow-up interval for patients suspected of having pregnancy failure, the use of an ultrasound machine to investigate and diagnose early pregnancy failure in conjunction with quantitative beta human chorionic gonadotropin hormone level assessment and progression gives definitive power in diagnosis and management for both normal and abnormal pregnancy outcome. This improves management and reduces miscarriage cases, as it can also predict actual miscarriage, which helps to prevent their occurrence.

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