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Original Article

Predictive Value of Yolk Sac Diameter in Cases of Miscarriage

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Abstract

Background: In early ultrasonography, pregnancies with a mean yolk sac diameter of equal to or more than 5 mm are also linked to a threefold increased risk of miscarriage in the first trimester. Understanding the predictive value of yolk sac diameter in cases of miscarriage can aid in improving risk assessment and patient management in early pregnancy.

Aim of the study: This study aimed to investigate the predictive value of yolk sac diameter with transvaginal ultrasound in cases of miscarriage.

Patients and Methods: This prospective study included 112 women in early pregnancy undergoing ultrasound assessment for various indications. Yolk sac diameter measurements will be obtained and correlated with pregnancy outcomes, focusing on the occurrence of miscarriage.

Results: There was a statistically significant difference among the study groups with respect to the location of the GS, the relationship amongst yolk sac size, shape, and/or echogenicity and abortion, the validity of each Yolk Sac abnormality in predicting abortion, & the accuracy of YS in predicting abortion.

Conclusion: The current investigation demonstrated a statistically significant rise in the probability of abortion among instances with an abnormally large yolk sac size, a missing yolk sac, and a hyperechogenic center. Furthermore, the results of this study demonstrated that The best cut off value for prediction of abortion was <2 & >6 with the sensitivity of the YS abnormality in the predication of abortion was 88%., specificity 76%, accuracy 82% .

Keywords: Yolk Sac Diameter; Miscarriage; Prediction.

INTRODUCTION

Pregnancy is one of the most miraculous experiences a woman can have, and it is also one of the most significant events in her life [1]. Ultrasonography [USG] plays a crucial role in distinguishing between normal and abnormal pregnancies, and by extension, it is vital for accurately predicting the health of the fetus. USG provides accurate diagnoses for the vast majority of pregnant women during the first trimester and, more importantly, allows for a reliable differentiation between a viable pregnancy and an abnormal pregnancy. In a woman with a positive serum human chorionic gonadotropin [hCG] reading, this sonographic finding is nearly diagnostic of an intrauterine pregnancy [2]. Ultrasonography is one of the most essential and effective diagnostic tools in modern medicine, and it has gained widespread acceptance as an integral part of fundamental investigative procedures. At around five weeks after the first day of the mother's last menstrual period, the gestational sac is first visible on transvaginal ultrasound imaging as a round or oval fluid collection in the central echogenic portion of the uterus. At this gestational age, the gestational sac has no discernible internal contents [3].

"Between 5 and 12 weeks of pregnancy, the yolk sac—the first embryonic component in the gestational sac—can be visualized as a tiny, anechoic zone that is deteriorating. The yolk sac [YS] is most functional between weeks 4 and 7 of embryonic development, and its presence can be readily recognized by transvaginal sonography [TVS] with a mean gestational sac diameter of five to six millimeters. When the gestational sac is larger than eight millimeters in diameter, it is recommended to direct the ultrasound beam at the yolk sac, which is located between the amnion and the chorion. The amnion is thin and difficult to visualize, but it is best seen when perpendicular to the ultrasound beam. As the pregnancy progresses, the amnion thickens and joins the chorion around the 12th to 16th week [4]. In the early stages of pregnancy, biometry involves calculating the average crown-rump length [CRL] and its relationship to the size of the gestational sac. Currently, the confirmation of intrauterine pregnancy is the most significant benefit of sonographic examination of the yolk sac. TVS can identify the yolk sac in the chorionic cavity between the fifth and twelfth weeks of pregnancy. TVS can detect a yolk sac diameter [YSD] of 3 to 5 mm, which is consistent with a healthy pregnancy. Many sonographic characteristics of the yolk sac, including its size, shape, and internal structure, have been found to correlate with pregnancy outcomes. Therefore, significant morphological alterations may signal problems with the embryo's transport system from the mother and may indicate impending embryonic demise [5].

The small extraembryonic tissue known as the yolk sac is extremely important throughout the first trimester of pregnancy. Functioning at its peak between weeks 4 and 7, it is essential for the development of the embryo by providing nutrients and carrying out endocrine, metabolic, and hematopoietic processes [6].

Even as late as week 10, the yolk sac can expand to a size ranging from two to five millimeters. Low birth weight babies are more likely to be born to mothers who have an abnormality in their yolk sac. Additionally, an early ultrasound showing a mean yolk sac diameter of five millimeters or more is a risk factor for miscarriage in the first trimester. Pregnancies in which no yolk sac is present or the yolk sac diameter is significantly less than expected for the gestational age are at risk of spontaneous termination. Large yolk sac pregnancies often have unfavorable outcomes [7].

THE AIM OF THE WORK

This study aimed to investigate the predictive value of yolk sac diameter with transvaginal ultrasound in cases of miscarriage.

PATIENTS AND METHODS

After receiving approval from the research and ethical council of the Faculty of Medicine at Al-Azhar University, a prospective cohort study was conducted in the maternity ward of Damietta Maternity Hospital. Women who were in their first trimester of pregnancy and attending their regular antenatal follow-up appointments were enrolled in the study. Twelve women were excluded from the study because they declined transvaginal sonography testing

The Inclusion criteria were; Gestational age between 6-10 weeks, Singleton pregnancy and Regular menstrual cycle.

Exclusion criteria were: Women with uterine or cervical abnormalities, multiple pregnancies, ectopic pregnancies, and known endocrine disorders [such as hypothyroidism and diabetes] that cause aberrant pregnancy outcomes should be monitored closely. After being briefed on all aspects of the research, participants signed a consent form indicating their understanding of the study. The participants were fully informed about their rights as well as the nature, objectives, benefits, and any potential risks of the clinical study. Women signed a permission form showing their familiarity with the study after being thoroughly briefed on it.

Statistical analysis: The statistical program for the social sciences, version 23.0, was used to conduct the analyses of the collected data [SPSS Inc., Chicago, Illinois, USA]. Mean ± standard deviation, and ranges were used to describe the quantitative data. Frequencies and percentages were used to express the categorical data. Groups compared by independent samples or Chi square tests for continuous and categorical data, respectively. P value < 0.05 was significant.

RESULTS

The patient's age ranged from 19 to 39 years, while the BMI ranged from 18 to 25 kg/m². The majority of study subjects were multiparous [75.5%]. Previous abortions were reported by 18.4% of participants, and a history of cesarean delivery was reported among 43.2%. Detailed data on the 98 women included in the study are presented in Table 1. The characteristics of the yolk sac are shown in Table 2. The yolk sac was centrally located in 50.0% of cases, with 70.4% being of normal size [3-5 mm]. Its shape was regular in 75.5% of cases, and the majority of sacs were hypoechoic on ultrasound [81.6%] [see Table 2].

Table 3 displays statistically significant differences between viable and non-viable groups concerning the central, fundal, and low sites of the gestational sac. However, there is no statistically significant difference between the groups regarding the central location of the gestational sac. Table 4 shows significantly higher frequencies of non-viable cases among instances with an absent yolk sac, a low site, size <3 mm, size >5 mm, irregular shape, and hyper-echogenicity, with a p-value < 0.05.

Table 5 displays a statistically significant increase in the prevalence of non-viable cases among those with abnormal yolk sacs compared to normal cases [p < 0.001]. Table 6 shows that the accuracy of an absent yolk sac in predicting abortion was 100%, while that for small size was 74.5%, large size was 73.5%, irregular shape was 78.6%, and hyper-echogenic center was 68.4%. A receiver operating characteristic [ROC] curve was performed for the yolk sac and demonstrated an area under the curve of 0.820 with a p-value < 0.001. The optimal threshold values for predicting abortion were <2 mm and >6 mm, with sensitivity of 88% and specificity of 76% [Figure 1]..

Table [1]: The distribution of baseline characteristics among the study population [n=98].

	Baseline characteristics	Total [n=98]
Age [years]	Range	19-39
	Mean±SD	27.65±6.33
BMI [wt/[ht]^2]	Range	18-25
	Mean±SD	21.28±2.39
Gravidity [n,%]	Multigravidae	74 [75.5%]
	Primigravidae	24 [24.5%]
Previous abortion [n,%]	No	80 [81.6%]
	Yes	18 [18.4%]
Previous CS delivery [n=74] [n,%]	CS	32 [43.2%]
	NVD	18 [24.3%]
	Both	24 [32.4%]

Table [2]: Yolk Sac distribution among study group [n=98].

	Yolk Sac	Total [n=98]
Site [n,%]	**Absent**	8 [8.2%]
	Central	49 [50.0%]
	Fundal	26 [26.5%]
	Low	15 [15.3%]
Size of Yolk sac [n,%]	**Less than 3mm**	12 [12.2%]
	Normal 3-5 mm	69 [70.4%]
	More than 5mm	9 [9.2%]
	Absent	8 [8.2%]
Shape [n,%]	**Absent**	8 [8.2%]
	Irregular	16 [16.3%]
	Regular	74 [75.5%]
Echogenicity [n,%]	**Absent**	8 [8.2%]
	Hyperechoic	10 [10.2%]
	Hypoechoic	80 [81.6%]

Table [3]: Comparative analysis of viable and nonviable groups based on GS location.

Site of GS	Viable Group [n=63]	Non-Viable [n=35]	Test	p-value
Central	33 [52.4%]	18 [51.4%]	0.009	0.925
Fundal	25 [39.7%]	5 [14.3%]	***6.762***	***0.009****
Low	5 [7.9%]	12 [34.3%]	***10.835***	***<0.001****

Table [4]: Relationship between the size, shape, or echogenicity of the yolk sac and abortion.

Yolk Sac		Outcome at Second Visit				Chi-square test	
		Continue [Viable][n=63]		aborted [Non-Viable] [n=35]			
		No.	%	No.	%	x2	p-value
Site [n,%]	Absent	0	0.0%	8	22.9%	**15.552**	**<0.001****
	Central	34	54.0%	15	42.9%	**1.098**	**0.295**
	Fundal	25	39.7%	1	2.9%	**15.463**	**<0.001****
	Low	4	6.3%	11	31.4%	**10.848**	**<0.001****
Size [mm] [n,%]	Less than 3mm	1	1.6%	11	31.4%	**18.408**	**<0.001****
	Normal 3-5 mm	62	98.4%	7	20.0%	**65.689**	**<0.001****
	More than 5mm	0	0.0%	9	25.7%	**17.645**	**<0.001****
	Absent	0	0.0%	8	22.9%	**15.552**	**<0.001****
Shape [n,%]	Absent	0	0.0%	8	22.9%	**15.552**	**<0.001****
	Irregular	1	1.6%	15	42.9%	**27.774**	**<0.001****
	Regular	62	98.4%	12	34.3%	**49.479**	**<0.001****
Echogenicity	Absent	1	1.6%	7	20.0%	**10.048**	**0.002***
	Hyperechoic	3	4.8%	7	20.0%	**5.604**	**0.018***
	Hypoechoic	59	93.7%	21	60.0%	**16.891**	**<0.001****

Table [5]: Comparison of the viable and non-viable categories based on the Abnormality of Yolk Sac.

Abnormality Yolk Sac	Outcome at Second Visit				Total		Chi-square test	
	Viable		Non-Viable					
	No.	%	No.	%	No.	%	x2	p-value
Normal YS	59	93.7%	10	28.6%	69	70.4%	**42.667**	**<0.001****
Abnormal YS	4	6.3%	25	71.4%	29	29.6%		
Total	63	100.0%	35	100.0%	98	100.0%		

Table [6]: Validity of each of Yolk Sac abnormality in prediction of abortion.

Parameter	Sens.	Spec.	+PV	-PV	Accuracy	p-value
Absent	100.0%	100.0%	100.0%	100.0%	100.0%	<0.001*
Small Size [mm]	31.4%	98.4%	91.7%	72.1%	74.5%	<0.001*
Large Size [mm]	25.7%	100.0%	100.0%	70.8%	73.5%	<0.001*
Irregular Shape	42.9%	98.4%	93.8%	75.6%	78.6%	<0.001*
Hyper Echogenic	20.0%	95.2%	70.0%	68.2%	68.4%	0.041*

Table [7]: Predictive accuracy of YS in pregnancy.

Parameter	Cutoff	Sens.	Spec.	+PV	-PV	Accuracy	p-value
Yolk sac	<2&>6	88%	76%	78.6%	86.4%	82.0%	**<0.001**

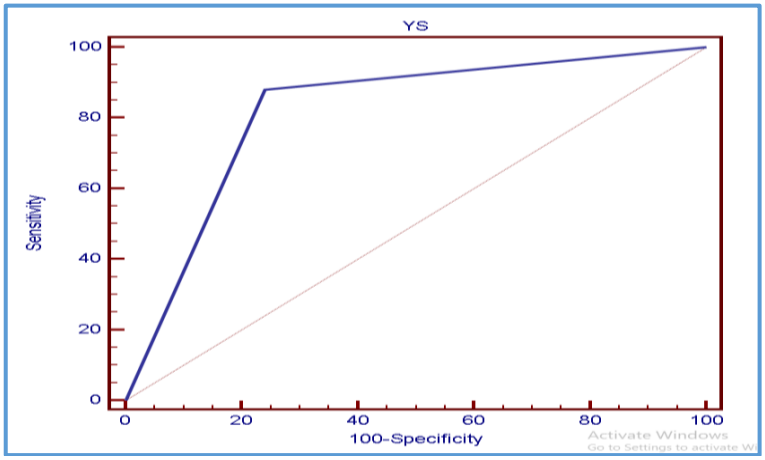

Figure [1]: Accuracy of YS in prediction of abortion.

DISCUSSION

Within the embryonic sac, the yolk sac is the first visible organ. The goal of the present research is to characterize the features of this structure. Accurate prediction of yolk sac characteristics and their relation to first trimester outcomes plays a crucial role in patient counseling and future management strategy planning. There is no statistically significant difference based on age, BMI, or parity, with a p-value of $p > 0.05$

This study shows that the accuracy of an absent yolk sac in predicting abortion was 100%. The accuracy for small yolk sac size was 74.5%, for large size it was 73.5%, for irregular shape it was 78.6%, and for hyper-echogenic center it was 68.4%. Pregnancies with yolk sac diameters [YSD] greater than 6 mm have a very high sensitivity [100%] and specificity [96%], as demonstrated in the study by **Bhattarai and Baral** [8]. This finding is consistent with our own results. Another retrospective study found that the continuation of pregnancy is most compatible when the YSD is between 2 and 6 mm, with rates of 20%, 89.2%, and 20%, respectively, for YSDs around 6 mm. However, the highest YSD for a healthy outcome was found to be 6.6 mm in the study by **Moradan and Forouzeshfar** [9].

In a study of 105 women, **Chama *et al.*** [10] reported that yolk sac diameter [YSD] predicted abnormal pregnancies with a sensitivity of 91.4%, specificity of 66.6%, and positive predictive value [PPV] of 88.8%. These values are consistent with our findings. Similarly, **Ashoush et al.** [11]'s investigation of 117 women found nearly the same values, with the exception of a higher negative predictive value of 95%. It is well documented that the yolk sac plays a key role in the embryo's normal morphologic development. However, there does not appear to be a maximum YSD value that reliably predicts an abnormal outcome. Furthermore, the normality of the YSD has been defined using multiple methods beyond simple biometry. Results may vary depending on factors such as study design, demographic characteristics, duration of follow-up, as well as the shape and quality of the yolk sac, its rim, and its central characteristics.

The current study found that the absence of a yolk sac was associated with an increased abortion rate, with an accuracy of 100%. This finding is in agreement with **Jose and Latheef** [12], **Varelas et ak.** [13], and **AbdulKadhim et al.** [14]. Regarding echogenicity, the current work detected that a hyper-echogenic center of the yolk sac was associated with an increased abortion rate, with an accuracy of 68.4%. This finding is in disagreement with **Moradan and Forouzeshfar [9]** and **Jose and Latheef** [12], who reported an accuracy of 100.0%.

Conclusion: Abortions were shown to be significantly more common in cases with an abnormally large yolk sac size, absence of the yolk sac, and a hyper-echogenic center, as demonstrated in the current study. Furthermore, the results of the investigation indicate that the optimal cutoff points for predicting abortion are <2 mm and >6 mm. The sensitivity of yolk sac abnormalities in predicting abortion was 88%, specificity was 76%, and accuracy was 82%. Large yolk size and a hypoechoic center are considered the most critical factors in predicting miscarriage in the first trimester of pregnancy. Further research with larger sample sizes is needed to assess the impact of other factors

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Conflict of Interest: None

REFERENCES

1. Srivastava G, Nagwani M, Tewari V, Kunwar S, Pasricha N, Sthapak E. The Correlation of Shape of Yolk Sac with Spontaneous Abortion-An Ultrasonographic Study. Era's J Med Res. 2018 Jul 1;5[2]:128-33. DOI: 10.24041/ejmr2018.78.

2. Phillips CH, Benson CB, Durfee SM, Heller HT, Doubilet PM. "Pseudogestational Sac" and Other 1980s-Era Concepts in Early First-Trimester Ultrasound: Are They Still Relevant Today? J Ultrasound Med. 2020 Aug; 39[8]:1547-1551. DOI: 10.1002/jum.15243.

3. Doublets PM, Benson CB, Bourne T, Blaivas M; Society of Radiologists in Ultrasound Multispecialty Panel on Early First Trimester Diagnosis of Miscarriage and Exclusion of a Viable Intrauterine Pregnancy; Barnhart KT, Benacerraf BR, Brown DL, Filly RA, Fox JC, Goldstein SR, *et al*. Diagnostic criteria for nonviable pregnancy early in the first trimester. N Engl J Med. 2013 Oct 10; 369[15]:1443-51. DOI: 10.1056/NEJMra1302417.

4. Levi CS, Lyons EA, Dashefsky SM, Lindsay DJ, Holt SC. Yolk sac number, size and morphologic features in monochorionic monoamniotic twin pregnancy. Can Assoc Radiol J. 1996 Apr; 47[2]:98-100. PMID: 8612093.

5. Tudorache Ș, Căpitănescu RG, Drăgușin RC, Zorilă GL, Marinaș MC, Cernea N, Pătru CL. Implications of the First Trimester 2d and 3d Ultrasound in Pregnancy Outcome. Curr Health Sci J. 2019 Jul-Sep; 45[3]:311-315. DOI: 10.12865/CHSJ.45.03.10.

6. Odland Karlsen H, Johnsen SL, Rasmussen S, Trae G, Reistad HMT, Kiserud T. The human yolk sac size reflects involvement in embryonic and fetal growth regulation. Acta Obstet Gynecol Scand. 2019 Feb; 98[2]:176-182. DOI: 10.1111/aogs.13466.

7. Suguna B, Sukanya K. Yolk sac size & shape as predictors of first trimester pregnancy outcome: A prospective observational study. J Gynecol Obstet Hum Reprod. 2019 Mar; 48[3]:159-164. DOI: 10. 1016/j.jogoh.2018.10.016.

8. Bhattarai A, Baral G. Yolk sac diameter as a prognostic factor for first trimester pregnancy outcome. Nep J Obstet Gynaecol. 2020 Jun 7; 15[1]:39-42. DOI: 10.3126/njog.v15i1.29339.

9. Moradan S, Forouzeshfar M. Are abnormal yolk sac characteristics important factors in abortion rates? Int J Fertil Steril. 2012 Jul; 6[2]:127-30. PMID: 25493170.

10. Chama CM, Marupa JY, Obed JY. The value of the secondary yolk sac in predicting pregnancy outcome. J Obstet Gynaecol. 2005 Apr; 25[3]:245-7. DOI: 10.1080/01443610500060677.

11. Ashoush S, Abuelghar W, Tamara T, Aljobboury D. Relation between types of yolk sac abnormalities and early embryonic morphology in first-trimester missed miscarriage. J Obstet Gynaecol Res. 2016 Jan; 42[1]:21-8. DOI: 10.1111/jog.12837.

12. Jose L, Latheef NA. Sonographic evaluation of yolk sac. Int J Sci Engineering Res 2015; 6[5]:11-5.

13. Varelas FK, Prapas NM, Liang RI, Prapas IM, Makedos GA. Yolk sac size and embryonic heart rate as prognostic factors of first trimester pregnancy outcome. Eur J Obstet Gynecol Reprod Biol. 2008 May; 138[1]:10-3. DOI: 10.1016/j.ejogrb.2007.06.023.

14. Abdulkadhim S, Jassam N, Mohammed TN, Abdulkhader H, Al-Saadi WI. Predictors of poor first trimester outcome in asymptomatic women: the value of embryonic heart rate, mid sac diameter/yolk sac ratio & mid sac diameter/crown rump length. Al-Kindy College Med J 2017; 13[2]:46-50.DOI: 10.47723/kcmj.v13i2.93.

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