Yolk Sac Diameter and Shape via Transvaginal Ultrasonography as prognostic factor of First Trimester Pregnancy Outcomes

Obstetrics & Gynecology

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ABSTRACT

Background: Miscarriage accounts for around 15-20% of all pregnancies. The yolk sac emerges at 5 weeks of pregnancy and may be seen by ultrasound. The embryonic heart rate can be utilized as a predictive factor for the pregnancy outcome in the first trimester.

Aim of the work: To see whether measuring the width and form of the yolk sac using a transvaginal ultrasound at 6 and 8 weeks of pregnancy will help predict the fate of the first trimester pregnancy.

Patients and methods: This is a cross sectional research , was done at El- Sayed Galal Hospital of Al-Azhar University and Kafr El-Sheikh General Hospital on 100 pregnant ladies were attended antenatal care visits, during the period from April 2021 till the end of the study.

Results: yolk sac diameter at in different gestational ages were significantly lower among good outcome group compared to abortion group.

Conclusion: Yolk Sac Diameter and Shape may be utilized as a predictive factor for First Trimester Pregnancy Outcomes using Transvaginal Ultrasonography. As a result, in the age of assisted reproductive technologies, this measure might be utilized as a useful tool in medical practice to predict whether a pregnancy would be successful or not. More research is required to corroborate the current results.

Keywords: *first trimester; Pregnancy outcome; Ultrasonographic evaluation; yolk sac.*

INTRODUCTION

Pregnancy is one of the most marvelous events which a woman experiences in her life and reality of the whole life, the first trimester is a vital time as the pregnancy gets established.[1]

It's still difficult to tell the difference between a normal pregnancy and a pregnancy loss in the early stages of pregnancy. Approximately 30–40% of implanted pregnancies end in spontaneous abortion during the first trimester, according to estimates.[2]

Early in pregnancy, a large number of losses occur; however, after embryonic heart activity appears, the risk of spontaneous abortion steadily drops to 2-5 percent.[3]

There is a need for a precise way of assessing early pregnancies that enables for the early detection of unfavorable outcomes. This may help lead a specific and proactive treatment plan for the pregnant mother, as well as provide much-needed psychological preparation.[4]

On ultrasonography, the yolk sac (YS) is the first embryonal structure seen within the gestational sac (GS). It may be detected as early as 5 weeks of pregnancy, or 3 weeks of embryonal life, and its existence indicates pregnancy.[5]

The YS serves as the embryo's principal source of red blood cells and germinal stem cells. The previous belief that the YS was involved in the transport of nutrients to the embryo during the third–fourth week of pregnancy has been disproved. At 4–7 embryonic weeks of gestation, the YS achieves its peak degree of functioning. It grows in size in a linear pattern until it reaches 10 weeks of pregnancy. The YS progressively degenerates as its function and vascularity decline, and it can no longer be detected after 12 weeks of pregnancy.[6]

With traditional sonography and, more recently, with TVS, several investigations on the predictive importance of the Yolk sac for pregnancy outcome have been conducted. The findings are contradictory. The size and form of the yolk sac has been proposed as sensitive indicators of pregnancy outcome. As a

result, further research into the size and structure of the yolk sac, as well as its relationship to normal and abnormal pregnancy outcomes, might aid as an early predictor of pregnancy outcome.[2]

The aim of this research was to see whether measuring the yolk sac diameter and form using a transvaginal ultrasound between 6 and 8 weeks of pregnancy may help predict the fate of the first trimester pregnancy.

PATIENTS AND METHODS

This was a cross sectional research that had been done at El- Sayed Galal Hospital of Al-Azhar University and Kafr El-Sheikh general Hospital on a total of 100 pregnant ladies who had been attend antenatal care visits during the period from April 2021 till the end of the study.

Ethical approval: Approval of ethical committee had been obtained as well as written consent had been signed from all cases before participation in this study.

Inclusion criteria: Patients who had been sure of 1st day of last menstrual period with regular cycles, intrauterine Singleton pregnancy, gestational age from 6 to 8 weeks during the first trimester and age, parity and BMI

Exclusion criteria: Molar pregnancy, history of radiation or chemotherapeutic exposure. Recurrent fetal loss, any uterine pathology as myomas or Structural malformations of uterus and cervix and chronic diseases as (SLE, hypertension, diabetes and cardiac diseases) Multifetal pregnancy.

Methodology: Each patient had performed the following: Informed written consent had been taken from each participant before being involved in the study.

The eligible subjects included in this study had been subjected to the following: History taking (age, parity, chronic medical disease, such as diabetes mellitus and hypertension, previous surgeries and

prior history of abortion and menstrual history as the date of last menstrual period for estimation of the gestational age). Examinations: General examination, BMI, and abdominal examination. Tranvaginal ultrasonography: All patients were assessed between 6 and 8 gestational weeks utilizing transvaginal ultrasonography equipped with a real-time, 5-MHz sector electronic array endovaginal probe.

A scan of the uterus and adnexa had been performed. The gestational sac and embryo were found intrauterine, and the embryo's crown rump length (CRL) was measured to confirm the gestational age and assess heart activity. After confirming embryo viability, the yolk sac diameter (YSD) was calculated by positioning the callipers in the centre of the yolk sac wall and taking the measurements middle-to-middle.

Follow up: At 9 and 12 weeks of gestation, the chosen patients were assessed for heart rate, yolk sac size and form. Following then, aberrant pregnancy outcomes were documented. The study's endpoint and ultimate normal pregnancy result was a viable pregnancy at 12 weeks.

Statistical Analysis: SPSS 22.0 for Windows was used to collect, tabulate, and analyze all data (SPSS Inc., Chicago, IL, USA). The Shapiro Walk test was used to determine the normal distribution of the data. Frequencies and relative percentages were used to depict qualitative data. As mentioned, the chi square test (χ2) and Fisher exact were employed to determine the difference between qualitative variables. For parametric data, the average ± SD (standard deviation) were used; for non-parametric data, the mean and ranges were used. For parametric and non-parametric variables, the independent T test and Mann Whitney test were employed to determine the difference between quantitative variables in two groups. All statistical comparisons were made using two-tailed significance levels. P-values $\leq$ 0.05 indicate a substantial difference, $p < 0.001$ indicate a very substantial difference, and $P > 0.05$ represent no difference.

RESULTS

Variables	Good outcome (n=87)	Abortion (n=13)	t	P
Age (years) Mean ±SD	25.31 ± 5.19	27.68 ± 4.63	1.56	.123
Parity Mean ±SD	1.59 ± 1.13	1.72 ± 1.02	z .362	.647
BMI (kg/m^2) Mean ±SD	26.45 ± 2.29	28.03 ± 2.68	2.27	.025

Table 1: Demographic characteristics distribution between the two groups

There is a statistically substantial variation in BMI between the groups. Table (1)

	Good outcome (n=87)		Abortion (n=13)		χ^2	P
	N	%	N	%		
Normal	85	97.7	1	7.7	80	.000
Large	1	1.1	4	30.8		
Absent	0	--	6	46.2		
Echogenic	1	1.1	0	--		
Small	0	--	2	15.4		

Table 2: Yolk sac distribution among studied groups

There is a highly substantial variation in yolk sac abnormalities across the groups. Table (2)

Variables	Good outcome (n=87)	Abortion (n=13)	t	P
6th week Mean ±SD	2.54 ± 0.202	2.85 ± 0.731	2.96	.004
7th week Mean ±SD	3.02 ± 0.188	3.66 ± 0.712	7.06	.000
8th week Mean ±SD	3.24 ± 0.296	4.05 ± 0.871	6.61	.000
9th week Mean ±SD	3.85 ± 0.285	3.64 ± 0.573	2.12	.037
10th week Mean ±SD	4.12 ± 0.301	3.19 ± 0.541	9.2	.000
11th week Mean ±SD	4.31 ± 0.370	2.82 ± 0.472	11.5	.000
12th week Mean ±SD	4.75 ± 0.418	2.36 ± 0.557	17	.000

Table 3: Yolk sac diameters between the two groups

Yolk sac diameter at in different gestational ages of 6th, 7th and 8th week were significantly lower among good outcome group compared to abortion group. However, yolk sac diameter at in different gestational ages of 9th to 12th week was significantly lower among good outcome group compared to abortion group. Table (3)

Variables	Good outcome (n=87)	Abortion (n=13)	t	P
6th week Mean ±SD	5.01 ± 0.608	3.32 ± 0.762	9.04	.000
7th week Mean ±SD	11.75 ± 0.774	5.05 ± 0.469	30	.000
8th week Mean ±SD	17.61 ± 0.588	5.19 ± 0.711	69	.000
9th week Mean ±SD	24.89 ± 0.837	10.62 ± 2.87	38	.000
10th week Mean ±SD	31.26 ± 0.457	7.23 ± 1.88	102	.000
11th week Mean ±SD	38.54 ± 0.637	5.12 ± 0.934	165	.000
12th week Mean ±SD	45.11 ± 0.873	4.56 ± 0.657	160	.000

Table 4: Crown-rump length between the two groups

CRL were considerably greater in the good result group than in the abortion group at various gestational ages. Table (4)

Variables	Good outcome (n=87)	Abortion (n=13)	t	P
6th week Mean ±SD	117.2 ± 3.82	113.2 ± 9.45	2.76	.007
7th week Mean ±SD	136.5 ± 5.13	115.6 ± 12.84	10.6	.000
8th week Mean ±SD	162.1 ± 6.43	123.3 ± 30.11	10.8	.000
9th week Mean ±SD	166.35 ± 2.86	127.41 ± 32.15	11.3	.000
10th week Mean ±SD	167.64 ± 4.33	112.09 ± 28.67	17	.000
11th week Mean ±SD	168.25 ± 4.65	124.18 ± 35.69	11.2	.000
12th week Mean ±SD	168.97 ± 4.84	118.43 ± 33.79	13.4	.000

Table 5: Cardiac activity distribution between the two groups

Cardiac activity was considerably greater in the good result group than in the abortion group at various gestational ages. Table (5)
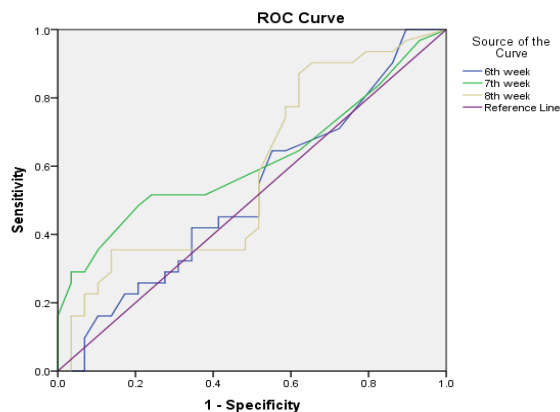
Fig 1: ROC curve for yolk sac diameters at different gestational ages as a predictor for poor pregnancy outcome

YSD	AUC	S.E.	Sig.	95% Confidence Interval	Sensitivity	Specificity
6th week	.523	.075	.762	.375 - .671	71%	72.4%
7th week	.615	.074	.126	.471 - .760	86.3%	69%
8th week	.586	.076	.252	.438 - .734	77.4%	75.9%

DISCUSSION

Ultrasonography is a critical and valuable diagnostic technique in contemporary medicine. Due to its non-invasive nature, safety, and lack of radiation risks, it has acquired widespread acceptance as a vital element of routine investigative processes. Ultrasound has many benefits over conventional techniques, including ease, mobility, speed, and accuracy. [7]

This Cross-sectional study that was conducted at ElSayed Galal Hospital of Al-Azhar University and Kafr El-Sheikh general Hospital on a total of 100 pregnant ladies attended antenatal care visits during the period from April 2021 till the end of the study. The studied cases were divided to 2 groups: good outcome group and Abortion group.

Regarding age, parity and BMI, the present research revealed that the median age of the good outcome group was (25.31 ± 5.19) years and abortion group was (27.68 ± 4.63) years, the mean parity for the good outcome group was (1.59 ± 1.13) and abortion group was (1.72 ± 1.02) and the mean BMI for the good outcome group was (26.45 ± 2.29) kg/m^2 and abortion group was (28.03 ± 2.68) kg/m^2. There was a statistically substantial variance between groups in terms of BMI (p=.025), but not in terms of age or parity (p =.123 and.647, respectively).

In accordance with our findings, Ghali et al., [1] found that the average age of the participants group was 23.94±3 years and the majority of cases aging from 20 to 31 years (72.44%) and there was no significant relationship between maternal age and pregnancy outcome.

Additionally, the research by Lebda et al., [8] concurs with our findings, since they discovered no substantial association between maternal age and pregnancy outcome.

In agreement with our results the study by Anjana & Sheikh, [9] revealed that the mean age of the study group was 23.94±3 years and the majority of cases aging from 20 to 31 years (72.44%).

In line with our results Bhattarai & Baral, [4] revealed that the median age of participants was 24.01±4.76 years (range: 17-36). Mean BMI was 22.14±2.87 kg/m2 (range: 15.62-28.93).

Regarding Yolk sac distribution among studied groups, we found that the majority of good outcome group (97.7%) have normal yolk sac, while in the abortion group the majority of the cases have absent yolk sac (46.2%). There was a highly substantial variation in yolk sac abnormalities across the groups.

In agreement with our findings, the study by Suguna & Sukany, [2] found that Out of 500 individuals scanned at recruitment, 486 (97.8 percent) had a yolk sac and 14 had none (2.8 percent). While six of the 91 missed abortions lacked a yolk sac. They determined that the presence or absence of a yolk sac had a highly relevant effect on the outcome of pregnancy.

While the study by Ghali et al., [1] revealed that yolk sac was absent in three cases (4%), and all of them aborted later. They found that the majority of outcome group (96.8%) have normal yolk sac, while in the abortion group (n=9) 3 cases have absent yolk sac (33.3%) and 3 cases have normal yolk sac (33.3%). There was no substantial distinction in yolk sac abnormalities between the groups.

While the yolk sac size was normal in 62 (88.57 percent) of the cases studied by Srivastava et al., [10], it was smaller in one (1.4 percent) instance and abnormally inflated in another seven (10 percent) cases.

Whereas the study by Nawal et al., [11] revealed that An absent, irregularly formed, and relatively yolk sac was discovered in anembryonic gestations.

Regarding the Yolk sac diameters (YSD) of the studied groups, we found that the yolk sac mean diameter in the 6th gestational week was 2.54 ± 0.202 and 2.85 ± 0.731mm for the outcome and aborted

groups respectively, in the gestational week was 7th 3.02 ± 0.188 and 3.66 ± 0.712mm for the outcome and aborted groups respectively, and in the 8th gestational week was 3.24 ± 0.296and 4.05 ± 0.871mm for the outcome and aborted groups respectively. we also found that yolk sac diameter at in different gestational ages were significantly lower among good outcome group compared to abortion group. And the mean YSD was progressively increasing with advancing gestational age from 6 weeks to 8 weeks.

In line with our results Ghali et al., [1] revealed that that the yolk sac mean diameter in the 6th gestational week was 3.43±0.52mm and 2.74±0.91mm for the outcome and aborted groups respectively, in the gestational week was 7th 3.75±0.63 mm and 4.72±3.2 mm for the outcome and aborted groups respectively, and in the 8th gestational week was 4.4±0.96 mm and 5.4±3.9 mm for the outcome and aborted groups respectively. They also found that there was non-significant difference in the yolk sac diameter at different gestational ages for both groups.

In contrast to our results Suguna, & Sukanya, [2] revealed that Yolk sac diameter (YSD) (A normal range of 3–5 mm was used.) YSDs of less than 3 mm and more than 5 mm were deemed abnormal). A substantial link was discovered between aberrant YSD and poor pregnancy outcomes (p <0.000). The mean YSD grew from 3.27 to 3.9 mm by the 9th week 6 days, then dropped after 10 weeks.

In the study by Anjana & Sheikh, [2] they reported that mean YSD was 4.32±1.01 mm and the mean YSD was progressively increasing with advancing gestational age from 6 weeks to 10 weeks 6 days.

Whereas in study by Srivastava et al, [10] in India, The average YSD was 3.71.8 mm, with the smallest yolk sac being 1.25 mm and the biggest measuring 8.96 mm in diameter.

While the study by Srivastava et al., [10] reported that The average diameter of the yolk sac was found to be 3.7±1.8 mm. The tiniest yolk sac was 1.25 mm in diameter, while the biggest measured 8.96 mm.

Regarding the Crown-rump length (CRL) of the two groups the present results showed that the Crown-rump length in the 6th gestational week was 5.01 ± 0.608 and 3.32 ± 0.762 for the outcome and aborted groups respectively, in the 7th gestational week was 11.75 ± 0.774 and 5.05 ± 0.469 for the outcome and aborted groups respectively, and in the 8th gestational week was 17.61 ± 0.588 and 5.19 ± 0.711 for the outcome and aborted groups respectively. We also discovered that CRL was considerably greater in the excellent result group compared to the abortion group at various gestational ages.

In agreement with our findings the research by Tan et al., [12] revealed that change in CRL at different gestational ages were statistically significant.

While the study by Bhattarai & Baral, [4] concluded that Between seven and ten weeks of pregnancy, crown rump length measured by transabdominal ultrasonography was positively connected with

gestational age, although there was little difference in Yolk sac diameter.

Regarding the Cardiac activity distribution for the studied groups we found that in the 6th gestational week the Cardiac activity was 117.2 ± 3.82 and 113.2 ± 9.45 for the outcome and aborted groups respectively, in the 7th gestational week was 136.5 ± 5.13 and 115.6 ± 12.84 for the outcome and aborted groups respectively, and in the 8th gestational week was 162.1 ± 6.43 and 123.3 ± 30.11for the outcome and aborted groups respectively. The cardiac activity at in different gestational ages was significantly higher among good outcome group compared to abortion group.

While the study by Suguna & Sukanya, [2] 478 cases were analyzed and they found that in 392 (99.7%) of instances, heart activity was detected on the initial scan, indicating a positive result. At the initial visit, thirty-two (37.6%) instances with missed abortion showed no heart activity (p = 0.000).

In accordance to our results Srivastava et al., [10] showed that There is a strong association between the size of the yolk sac and the fate of the pregnancy (p-value <0.001).

Using ROC curve for yolk sac diameters at different gestational ages as a predictor for poor pregnancy outcome, regarding our results we found that the area under the curve (AUC) of ROC curve, Sensitivity and Specificity at 6th week were (0.523, 71% and 72.4% respectively), at 7th week were (0.615, 86.3% and 69% respectively), and at 8th week were (0. 586, 77.4% and 75.9% respectively). So, using yolk sac diameters, the pregnancy outcome can be detected better in the 7th gestational week, while the study by Anjana & Sheikh, [9] reported that the sensitivity was more i.e., 66.67% for 8 weeks – 8 weeks 6 days group and 10 weeks - 10 weeks 6 days group. The sensitivity and PPV was not good for 7 weeks 7 weeks 6 days group. The specificity was high in 9 weeks - 9 weeks 6 days group which was 95.08%. Among all gestational age groups, the sensitivity, specificity, PPV and NPV was high for 8 weeks – 8 weeks 6 days group which shows that YSD is more valuable tool in predicting pregnancy outcome in this particular gestational age group. In overall, YSD has good NPV i.e. 91.54% but poor PPV. The overall sensitivity and specificity of YSD was 50% and 83.64%.

In comparison with our results Ghali et al., [1] revealed that the predictive value of combining YSD and GA (area under the ROC curve: 0.616) for pregnancy outcome, with a sensitivity of 96.8% and specificity of 50.0 percent, and the conclusion that yolk sac diameter and shape as a single parameter is a poor predictor of pregnancy outcome beyond 20 weeks and may only be related to early pregnancy loss. While the study by Abd ellatif et al. [3] reported 75% sensitivity and 63.5% specificity and concluded that Yolk sac diameter only was a weaker predictor of abnormal outcome.

Also, the study by Bhattarai & Baral, [4] Revealed that Sensitivity, specificity, positive predictive value, and negative predictive value were computed and found

to be 92.95 percent, 66.6 percent, 95.6 percent, and 54.54 percent, respectively. When YSD was employed as a predictor to assess the first trimester pregnancy outcome, its sensitivity and PPV were both over 90%. They determined that YSD's sensitivity and positive predictive value (PPV) were both acceptable for predicting the outcome of a first-trimester pregnancy.

While the study by Manchanda et al., [13] revealed that Pregnancies with a YSD more than six mm had a sensitivity and specificity of 100 and 96 percent, respectively, for predicting detrimental impacts.

CONCLUSION

Even before embryonic morphology can be investigated sonographically, abnormalities in yolk sac size may be employed as a good predictor of early pregnancy loss. According to our findings, Yolk Sac Diameter and Shape as measured by Transvaginal Ultrasonography may be utilized as a predictor of First Trimester Pregnancy Outcomes. As a result, in the age of assisted reproductive technologies, this measure might be employed as a useful tool in clinical practice to predict whether a pregnancy would be successful or not.

Conflict of interest : none

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