



Yolk sac size and embryonic heart rate as prognostic factors of first trimester pregnancy outcome

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Abstract

Background: Many studies on the prognostic significance of the Yolk sac for the pregnancy outcome have been performed with conventional sonography and more recently with TVS. The results are conflicting. This prospective co relational study is conducted to assess the correlation of first trimester pregnancy outcome using yolk sac measurements and embryonic heart rate.

Material & Methods: A Hospital based prospective study done on 100 pregnant women between 6-9 weeks of gestation who were attending the antenatal clinic in Department of Obstetrics and Gynaecology, Mahatma Gandhi Hospital, Bhilwara, Rajasthan. Follow up scan: was done every two weeks where (gestational sac diameter, yolk sac diameter, crown rump length and fetal heart rate) were measured every time until the pregnancy reached 12 weeks.

Results: The Yolk sac size varied between 2.5 to 7.0 with a mean of 4.892 mm. The Yolk sac size has significant correlation with the first trimester pregnancy outcome. (T-test $p=0.002^{**}$). The heart rate of the fetus predicted the first trimester pregnancy outcome significantly (T-test $p=0.048^{*}$).

The gestational Age at the time of first scan predicted very significantly the first trimester pregnancy outcome (T-test $p<0.001^{**}$). The Crown Rump Length (CRL) was ranged between 10 and 58 mm with a mean of 24.51 mm. The CRL has significant predictive value in first trimester pregnancy outcome (T-test $p=0.044^{*}$).

Conclusion: We concluded that yolk sac size and the embryonic heart rate is a reliable, cost effective and beneficial in predicting first trimester pregnancy outcome especially in patients who conceive following IVF.

Keywords: First trimester pregnancy, Yolk sac size, Crown rump length, Gestational age, Heart rate.

Introduction

Spontaneous abortions or early pregnancy failure is one of the most frequent complications of pregnancy, but great difficulty is still experienced in reliably anticipating which pregnancies will terminate in abortion. This situation is particularly distressing to those patients with history of threatened or recurrent abortion who abort despite resting in the hospital for many weeks.¹ Therefore

there is a need for techniques which will allow early diagnosis to be made in these patients, preferably with such certainty that a more active line of management can be pursued if so desired. The secondary yolk sac is the first extraembryonic structure that can be detected with transvaginal sonography (TVS) in the chorionic cavity and can be seen from the 5th to the 12th week menstrual age, at the latest. During organogenesis and before

placental circulation is established, yolk sac is the primary source of exchange between the embryo and the mother.² Yolk sac has nutritive, endocrine, metabolic, immunologic, secretory, excretory and hematopoietic functions. Many studies on the prognostic significance of the Yolk sac for the pregnancy outcome have been performed with conventional sonography and more recently with TVS. The results are conflicting. Ultrasound is the primary imaging modality in obstetrics over the last three decades. The advent of high-resolution transvaginal ultrasound (TVS) has revolutionized our understanding of the pathophysiology and the management of early pregnancy failure. Knowledge of the ultrasound appearances of normal early pregnancy development and a good understanding of its pitfalls are essential for the diagnosis and management of early pregnancy failure.³ Ultrasound imaging has rapidly replaced all other techniques used to study normal human development in the first trimester, and ultrasound features of the early gestational sac have corroborated anatomical studies showing that the first structures to appear are the coelomic cavity and the secondary yolk sac.⁴ No single ultrasound measurement of the different anatomical features in the first trimester has been shown to have a high predictive value for determining early pregnancy outcome. This prospective co relational study is conducted to assess the correlation of first trimester pregnancy outcome using yolk sac measurements and embryonic heart rate.

Material & Methods

A Hospital based prospective study done on 100 pregnant women between 6-9 weeks of gestation who were attending the antenatal clinic in Department of Obstetrics and Gynaecology, Mahatma Gandhi Hospital, Bhilwara, Rajasthan

Selection Criteria

Inclusion Criteria

- Pregnant women at menstrual age less than 10 weeks
- Antenatal patients with single gestation and live embryo

- Age < 30yrs

Exclusion Criteria

1. Molar pregnancy
2. Women with structural anomalies of uterus and cervix
3. Women with known endocrine disorder causing abnormal pregnancy outcome.
4. Pregnancy from infertility treatment
5. Cases without embryonic heart rate, anembryonic pregnancy, subchorionic haemorrhage and inconsistency between gestational sac size and CRL.
6. Women who has used any abortive or teratogenic drugs

Methods

Women attending routine antenatal check up in the out-patient department were subjected to scan. Only those antenatal women who have <30 years and of singleton pregnancy were included in the study.

A detailed history was elicited with special reference to the last menstrual period, its regularity and other associated risk factors like diabetes mellitus, hypertension, hypothyroidism, cardiac disease and bronchial asthma. Then a thorough general, physical, systematic and obstetric examination was carried out. After obtaining informed consent the women between less than 10 weeks of gestation were subjected to transvaginal ultrasound.

A first ultrasound scan: between 5 and 6 weeks of gestation according to their first antenatal care visit that included the following:

- Gestational sacs,
- The yolk sac diameter (YSD),
- Crow- rump length (CRL) measurement,
- Fetal heart rate measurements.

Follow up scan: was done every two weeks where (gestational sac diameter, yolk sac diameter, crown rump length and fetal heart rate) were measured every time until the pregnancy reached 12 weeks.

Statistical analysis

Descriptive analysis was done to find the mean and standard deviation. Analysis of variance (ANOVA) was performed to compare various groups. A “p” value of 0.005 or less considered as statistically significant.

Results

Age at the time of pregnancy and first Sonogram correlates with the first trimester pregnancy outcome (*One way ANOVA* p=0.028*). Mean age was 23.73 years with minimum 16 years and maximum of 36 years.

The Yolk sac size varied between 2.5 to 7.0 with a mean of 4.892 mm. The Yolk sac size has

significant correlation with the first trimester pregnancy outcome. (*T-test* p=0.002**). The heart rate of the fetus ranged between 100 and 180, with a mean of 154.62. The heart rate of the fetus predicted the first trimester pregnancy outcome significantly (*T-test* p=0.048*).

The gestational Age at the time of first scan predicted very significantly the first trimester pregnancy outcome (*T-test* p<0.001**) Gestational age ranged between 6.0 to 11.5 weeks with a mean of 8.426 weeks. The Crown Rump Length (CRL) was ranged between 10 and 58 mm with a mean of 24.51 mm. The CRL has significant predictive value in first trimester pregnancy outcome (*T-test* p=0.044*).

Table 1: Descriptive data of all cases

Data	Minimum	Maximum	Mean
Age (years)	16	36	23.73
Married since (years)	0.3	7.0	2.062
Gestational Sac Size (mm)	12	67	32.12
Yolk sac size (mm)	2.5	7.0	4.892
Heart Rate (Bpm)	100	180	154.62
Gestational Age (weeks)	6.0	11.5	8.426
Crown Rump Length (mm)	10	58	24.51

Table 2: Age and Pregnancy outcome

	Pregnancy outcome	N	Mean	Std. Deviation	Std. Error Mean
Age in years	Normal	82	23.41	3.697	0.366
	Miscarriage	18	25.50	3.451	0.813

Independent Samples Test

	t-test for Equality of Means					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Age in years	-2.230	118	0.028*	-2.09	-3.943	-0.234
	-2.341	24.415	0.028	-2.09	-3.928	-0.249

Table 3: Yolk sac Size and Pregnancy outcome

	Pregnancy outcome	N	Mean	Std. Deviation	Std. Error Mean
Yolk sac (mm)	Normal	102	4.804	0.7304	0.0723
	Miscarriage	18	5.389	0.6764	0.1594

	t-test for Equality of Means					
	t	df	Sig. (2-tailed)	Mean Difference	Confidence Interval of the Difference	
					Lower	Upper
Yolk sac (mm)	-3.165	118	0.002**	-0.585	-0.9509	-0.2190
	-3.341	24.541	0.003	-0.585	-0.9459	-0.2241

Table 4: Embryonic heart rate and pregnancy outcome

	Pregnancy outcome	N	Mean	Std. Deviation	Std. Error Mean
Embryonic Heart Rate (bpm)	Normal	102	155.88	14.298	1.416
	Miscarriage	18	147.44	26.203	6.176

	t-test for Equality of Means					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Embryonic Heart Rate (bpm)	1.994	118	0.048*	8.44	0.059	16.817
	1.332	18.825	0.199	8.44	-4.833	21.708

Table 5: Correlation of Pregnancy outcome with all other parameters (AFTER EXCLUDING THE CASES WITH UNKNOWN ‘LMP’)

One Way ANOVA with Post HOC Turkey test
ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gestational Sac Size	Between Groups	515.222	1	515.222	6.792	0.010*
	Within Groups	8040.518	106	75.854		
	Total	8555.741	107			
Yolk sac size	Between Groups	7.507	1	7.507	16.886	0.000**
	Within Groups	47.123	106	.445		
	Total	54.629	107			
Embryonic heart rate	Between Groups	1069.914	1	1069.914	3.763	0.055*
	Within Groups	30140.271	106	284.342		
	Total	31210.185	107			
Gestational age	Between Groups	23.553	1	23.553	18.119	0.000**
	Within Groups	137.791	106	1.300		
	Total	161.343	107			
CRL	Between Groups	196.721	1	196.721	3.257	0.074
	Within Groups	6401.529	106	60.392		
	Total	6598.250	107			

Discussion

Miscarriage occurs in approximately 30–40% of implanted pregnancies, is the commonest complication of pregnancy.⁵ Numerous studies have examined the potential value of demographic

characteristics and various ultrasonographic parameters in the prediction of those pregnancies that will miscarry.

Our study supports the fact that as the maternal age increases, chances of spontaneous abortion

also increases. Studies have also shown that the rate of spontaneous abortion following cardiac activity is influenced by maternal age. So a cardiac activity is not necessarily a reassuring sign in the older patient.⁶ Our study is in agreement with the fact that consanguinous marriage increases the adverse outcome. Consanguinous marriage is still prevalent in the population studied.

In our study Gestational sac mean size was 32.12 and significantly correlates with the first trimester outcome ($p=0.007^{**}$). It was 33.10 mm mean in the normal pregnancies and mean of 26.61mm in miscarriage group. It has long been recognized that there is wide scatter in gestational sac volume measurements in 'normal' early pregnancy.⁷ A smaller than expected gestational sac can be a predictor of poor pregnancy outcome, both alone and in combination with other parameters, even in the presence of embryonic cardiac activity, In very early pregnancy, there appears to be no difference in gestational sac diameter (GSD) when compared with pregnancy outcome, the difference only becoming apparent from 5 weeks onwards.⁸ Once a gestational sac has been documented on ultrasound, subsequent loss of viability in the embryonic period remains around 11%.⁹ So, Gestational sac size measurements could not be considered as good predictor of first trimester outcome even though it had significant correlation in our study.

The increase in yolk sac diameter during the first trimester and its correlation with advancing gestational age lie in agreement with most of the previous studies¹⁰, although some researchers support that the growth of yolk sac during the first trimester is not constant.¹¹ We demonstrated that the pregnancies with mean yolk sac diameter ≥ 5 mm on early ultrasound require monitoring and counseling. About a threefold increased risk for first-trimester loss independent of maternal risk factors such as age, body mass index, polycystic ovary syndrome, smoking, and diabetes and we agree with recent studies that support the negative predictive value of the absence of yolk

sac.^{12,13} We studied only the yolk sac size and not its shape; therefore we cannot comment on previous articles that associate abnormal shapes of the yolk sac with poor pregnancy outcome.¹⁴ In addition, enlarged yolk sac diameter may be associated with an increased risk of preterm delivery.¹⁵

Embryonic heart rate has significant correlation with the first trimester outcome in our study ($p=0.048^*$). FHR has been studied extensively and numerous studies have demonstrated a strong association between pathological FHR and fetal loss. Fetal bradycardia is a sign of impending fetal death reflecting the forthcoming collapse of the cardiovascular system. Another possible cause for the high miscarriage rate in fetuses with abnormal FHR is that there may be an underlying chromosomal abnormality, such as trisomy 18 or triploidy, which is associated with fetal bradycardia.¹⁶ But tachycardia is a feature of trisomy 21(Down Syndrome).¹⁷

The ultrasonographic estimation of gestational age in our study has significant correlation with pregnancy outcome ($p<0.001^{**}$). The inverse relationship between gestational age and fetal loss rate is consistent with the results of previous studies and may also be a consequence of the high early lethality of chromosomally abnormal embryos.¹⁸ For example, a previous study of 6337 pregnancies reported an inverse correlation between gestation and rate of subsequent fetal loss, which decreased by about 1% per week from 9.6% at 7 weeks to 2.3 at 14 weeks.¹⁹

In fetuses with CRL < 18 mm there was a significant positive association between the deficit in CRL for gestation and the incidence of subsequent spontaneous miscarriage.²⁰ In our study Crown rump length inversely associated with miscarriage ($p=0.044^*$). CRL is <22 mm in miscarriages in our study, this correlation stands with most of the previous studies. The measurement of fetal CRL may be a useful predictor of spontaneous miscarriage and SGA in pregnancies with threatened miscarriage.

The limitation of ultrasound examination depends

on the machine type, operator factors and timing of scan and our study also has limitation of low volume. In spite of all these limitations we postulate that measurement of yolk sac size and embryonic heart rate in early pregnancy may predict the first trimester outcome and plan for timing of follow up; also to counsel the patient about the short term and long term outcomes.

Conclusion

We concluded that yolk sac size and the embryonic heart rate is a reliable, cost effective and beneficial in predicting first trimester pregnancy outcome especially in patients who conceive following IVF.

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