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A study of yolk sac diameter in predicting abnormal outcome of pregnancy in rural hospital

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Abstract
Introduction: Early pregnancy loss is the most common complication of early pregnancy. First trimester is crucial, since 80% of pregnancy losses occur spontaneously during this period. There is great difficulty in reliably anticipating which pregnancies will terminate in abortion. The yolk sac is the first extra embryonic structure that becomes sonographically visible within the gestational sac. Aims and Objectives of the present study is to evaluate the size of yolk sac as a predictor of pregnancy outcome.
Material and Methods: The present Observational Prospective study was conducted on 104 pregnant woman with gestational age 6 to 10 weeks attending OPD in the department of obstetrics and gynaecology at MVJ Medical college and research hospital from December 2020 to December 2022
Results: In present study Mean age of the study participants was 25.31±4.483 and mean values of radiological findings were gestational age (days)56.28days ±8.120, MSD was 2.2545±0.99, YSD was 2.25±0.99, CRL was 1.29±0.66 and HR was 156.61±13.453. Majority of the study participants 71.2% had normal perinatal outcome. There is steady increase in YSD mean value and difference observed is statistically significant. Statistically significant differences were observed between normal and abnormal perinatal outcome.
Conclusion: Abnormalities of YS size or shape, early regression or absence can be used as poor predictor of first trimester pregnancy outcome, even before studying the fetal morphology.

Keywords: Yolk sac diameter, mean sac diameter, perinatal outcome

Introduction

Early pregnancy loss also known as pregnancy loss, fetal demise, miscarriage, or spontaneous abortion - 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]. First trimester is crucial, since 80% of pregnancy losses occur spontaneously during this period [2]. There is great difficulty in predicting which pregnancies will terminate in abortion.

Ultrasound is the primary imaging modality in obstetrics. With the advent of high-resolution transvaginal ultrasound (TVS), it has helped in 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.

The yolk sac is the first extra embryonic structure that becomes sonographically visible within the gestational sac and acts as the primary route of exchange between the human embryo and the mother before the placental circulation is established. It provides nutritional, metabolic, endocrine, immunologic, and hematopoietic functions during organogenesis in embryonic life, and is considered to reach its highest level of functional activity between the 4th and 8th week of embryonic development [3] and undergoes degeneration after the twelfth week. Yolk sac can be detected with TVS in chorionic cavity from 5th to 12th week of menstrual age. In normal pregnancy it is identified by YSD of 3 to 5 mm by TVS [4]. TVS can detects the yolk sac as early as the 5th week of pregnancy [5].

Various studies on yolk sac diameter and shape as a prognostic factor for pregnancy outcome have been done, but the results are variable. The accurate recognition of abnormal sonographic findings related to the yolk sac can be used to anticipate the course of pregnancy. And since this has not been studied in a rural setup, this study is being conducted here at rural Bangalore.

Methods

The present Observational Prospective study was conducted in the department of obstetrics and gynaecology at MVJ Medical college and research hospital, Hoskote, Bangalore during the period of December 2020 to December 2022

The study was conducted on 104 pregnant woman with gestational age 6 to 10 weeks attending OPD at MVJMC&RH, Bangalore who were fulfilling eligible selection criteria were studied prospectively.

Inclusion criteria

Pregnant women with gestational age from 6 to 10 weeks and of singleton pregnancy.

Exclusion criteria

- Pregnant patients refusing transvaginal sonography or who were unwilling for follow up.
- Ectopic pregnancy
- Molar pregnancy
- Blighted ovum
- Multiple gestation
- Women with uterine and cervical anomalies
- Endocrine disorders

Data regarding age, obstetric history and period of gestation of these cases were also noted from the OPD records.

Method of collection of data

All pregnant women in their first trimester meeting the inclusion criteria, visiting OPD at MVJMC & RH are explained about the study, with informed consent their sociodemographic information was collected by proforma by personal interview. Complete history taking particularly for obstetric history, menstrual history, medical disorder that affects pregnancy was taken. Then a thorough general physical examination and obstetric examination was carried out. After obtaining informed consent these women were subjected to transvaginal ultrasound. All examinations were performed using linear array real time B scan with 7.5 MHz transducer. Patients were asked to empty their bladder before the procedure. Head of the probe was cleaned, covered with a condom after applying ultrasonic jelly. Tip of the condom was smeared with lignocaine jelly for smooth insertion into the vagina. With the patient in the dorsal position, the probe was inserted slowly into the vagina so as to obtain a sagittal section of the uterus. The probe was rotated from 12 o'clock to 9 o' clock position (anticlockwise) to obtain a transverse section of the uterus. The transducer was gently panned side to side until the maximum depth of gestational sac is displayed. After freezing the image the maximum longitudinal diameter and the maximum anteroposterior diameter was measured. The yolk sac appears as a transonic mass within the gestational sac and it is measured by placing the caliper on the inner limits of longer diameter. The range of normal yolk sac diameter was considered to be 2-6 mm.

They were followed up till the end of their pregnancy and considered as normal pregnancy outcome if pregnancy continued till term and abnormal outcome if they had spontaneous abortion, missed abortion or demonstrable foetal anomalies. Outcome is assessed in terms of normal or miscarriage.

Statistical analysis: The data was collected and entered in MS Excel. The continues data was represented with mean and standard deviation. The data was presented in the form of percentages and proportions.

Results

A total of 104 study participants were included in the study and analysed.

In this study, 17 cases were from age group of 20 years or less than 20 years i.e. around 16.3% of total study population. Majority of cases i.e. around 40 cases belong to 21 to 25 years' age group which accounts for 38.5% of total study population and 12.5% of total study population were from 31-35years. In present study most of the study participants were in the age group 21-30 years old. Mean age of the study participants was 25.31 $\pm$ 4.483.

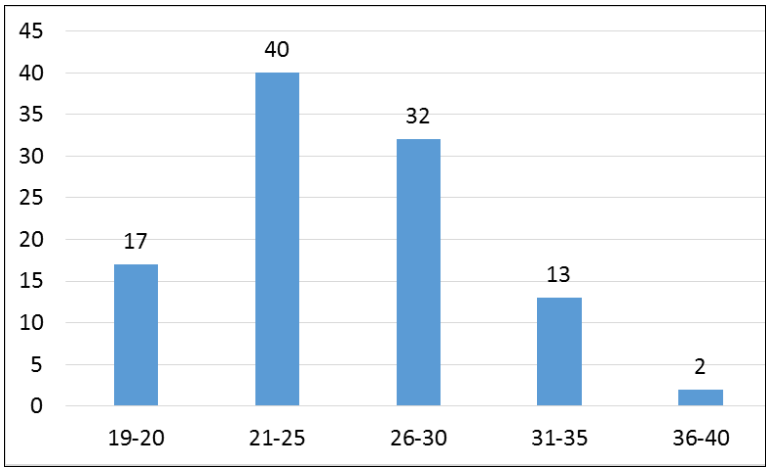

Fig 1: Age of the study participants

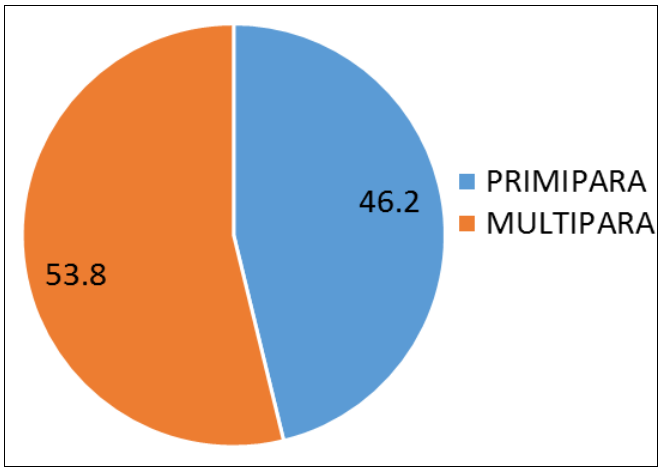

Fig 2: Parity of the study participants

In this study 48 cases were primipara and 56 cases were multipara. In present study most of the study participants were multipara 53.8%.(fig.2) In present study among multipara most of the study participants had parity 2 (42) constituting 40.4% and (14) 13.5% had parity 3. Most of the study participants had non consanguineous marriage 97.1%.

In this study, 21.2% (22) were from 6-7 weeks of GA, 27.9% (29) were from 7-8 weeks of GA, 26.0% (27) were from 8-9 weeks of GA, 25.0% (26) were from 9-10 weeks of GA

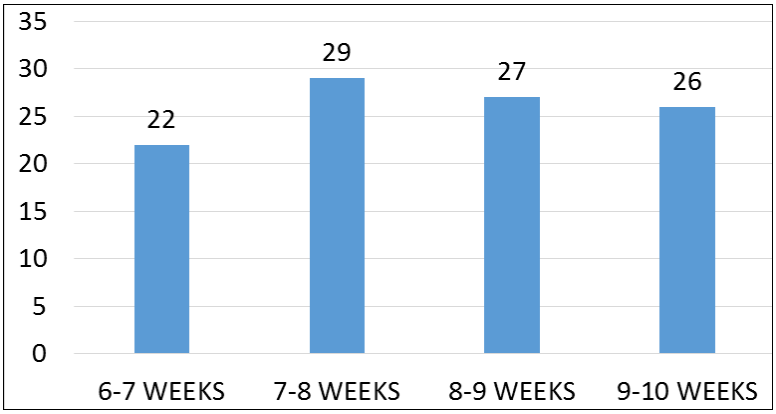

Fig 3: Gestational age of the study participants

Table1: Radiological findings of the study participants

Radiological findings	Mean	SD
Gestational age (Days)	56.28	8.120
MSD (cm)	2.2545	.99659
YSD (mm)	2.25	0.99
CRL (cm)	1.29	0.66
HR (bpm)	156.61	13.453

In the present study mean values of radiological findings were gestational age (days) 56.28days ±8.120, MSD was 2.2545±0.99659, YSD was 2.25±0.99, CRL was 1.29±0.66 and HR was 156.61±13.453. (Table.1)

Majority of the study participants 79.8% did not have any medical illness, only 20.2% had some medical illness, common illness was anaemia, 5.8% of participants had low Hb values than normal. (fig.4)

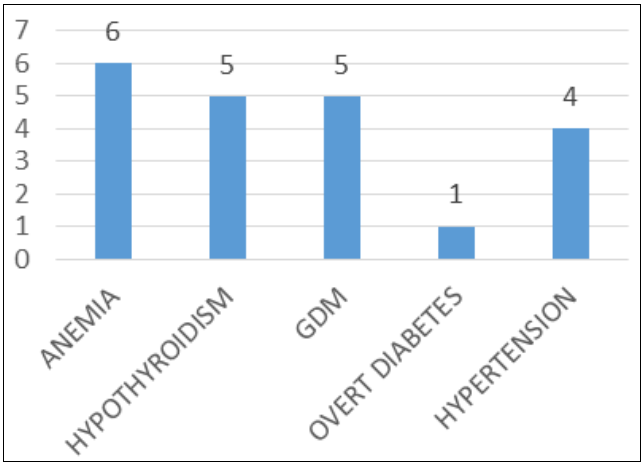

Fig 4: Medical illness of the study participants

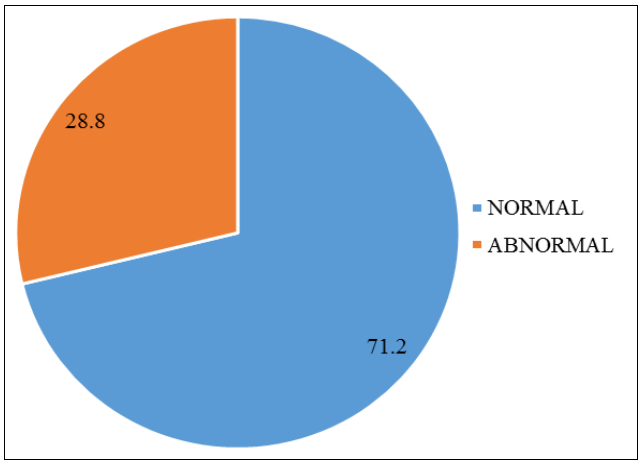

Fig 5: Perinatal outcomes of the study participants

Most of the study participants 71.2% (74) had normal perinatal outcome and 28.8% (30) had abnormal perinatal outcome.(fig.5) Pearsons correlation values for radiological findings were CRL 0.410, gestational age 0.343, MSD was 0.327. Differences observed were statistically significant.

Table 2: Correlation between ysd and other radiological parameters of the study participants

Radiological parameters		YSD
MSD	Pearsons correlation	0.327
	SIG. (2-TAILED)	0.001
	N	103
Gestational age	Pearsons correlation	0.343
	SIG. (2-TAILED)	0.000
	N	103
CRL	Pearsons correlation	0.410
	SIG. (2-TAILED)	0.000
	N	95

In present study there is steady increase in YSD mean value and difference observed is statistically significant. Similar observation found with CRL too (fig.6).

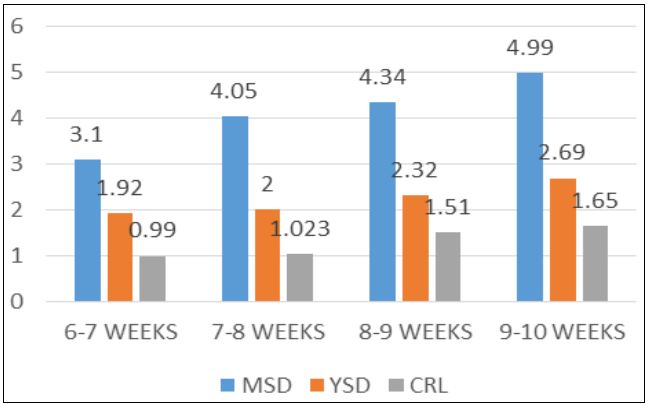

Fig 6: Correlation of gestational age with radiological parameters

In a present study radiological findings observed between normal and abnormal perinatal outcome statistically significant difference were seen. (Table.3).

Table 3: Correlation of perinatal outcomes with radiological parameters

Outcome		MSD	YSD	CRL
Abnormal	Mean	1.9507	4.0000	1.15
	N	30	29	21
	Std. Deviation	.99083	2.84906	0.80
Normal	Mean	2.3777	4.2355	1.33
	N	74	74	74
	Std. Deviation	.97879	1.14213	0.61
P value		0.047	0.549	0.276

The sensitivity was more i.e. 98% for gestational age group. The specificity was high in 9 weeks - 9 weeks 6 days group which was 93.08%. 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. This is the graph showing area under the curve; which is here around 0.604. It means around 60.4% of total cases of study population fall under this curve which is nothing but the accuracy of this study. (fig7)

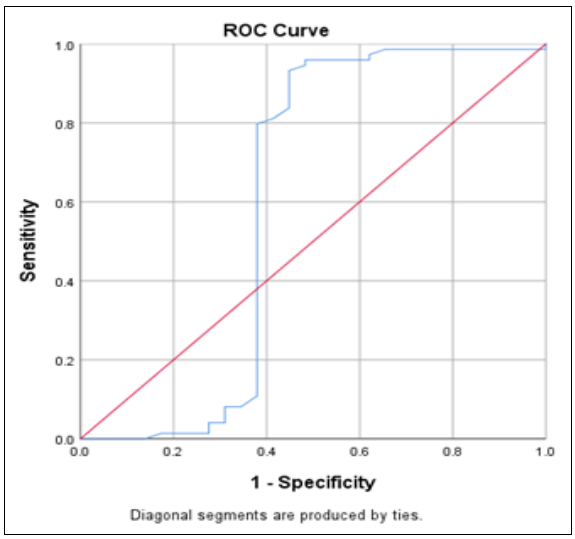

Fig 7: ROC curve

Discussion

In the first trimester yolk sac (YS) is the primary site of exchange between the embryo and the mother. YS have endocrine, immunologic, secretory, excretory functions as well as hemopoietic and nutritive properties. In this study, the YS was first identified endovaginally when the MGSD was 5.0 mm. Previously published data have shown that an absent YS with a MGSD of more than 8 mm is always abnormal when endovaginal US is used [6].

In present study Mean age of the study participants was 25.31 ± 4.483. In a study done by Saniya Sheikh *et al.* [7], 49 cases were from age group of 20 years or less than 20 years i.e. around 19.29% of total study population. Majority of cases i.e. around 72.44% belong to 21 to 30 years' age group and 8.27% of total study population were from 31 years or more than 31 years' age group. The mean age of the study group was 23.94±3 years. In the study by Moradan *et al.* [15] in Iran, the mean age of the study group was 28.1±5.8 years. Also in the studies by Adiga *et al.* and Sheikh S *et al.*, in India, there were no significant differences between outcomes with regard to maternal age [7, 16].

In present study most of the study participants most the participants 53.8%were multipara. In a study done by Laura Detti *et al.*, [8] majority were multipara, gravida 2 was most common among participants.

In the present study, the mean YSD was 2.25±0.99. Its size was progressively increased with advancing gestational age from 6-7 weeks to 9-10 weeks with mean values of 3.1 to 4.9 respectively. Srivastav *et al.* [9] study had the mean YSD of 3.7±1.8 mm and the diameter of the smallest yolk sac was 1.25 mm and that of the largest was 8.96 mm. In the study conducted by Tan S *et al.* [5] in Turkey, the mean YSD was 3.2±0.7 mm [10]. Chama *et al.*, [12] reported a linear increment in mean YSD from 2.27 mm at 5 weeks of gestation to 5.61 mm at 11 weeks of gestation.

Finding was also comparable to the Indian study by Rajani N *et al.* [13] in which progressively increased mean YSD was found with advanced gestational age between 5 - 9 weeks of GA, followed by either their disappearance (73.61%), or decreased size (26.38%) thereafter at 11 weeks of GA in cases with normal outcome [14].

In the present study mean values of radiological findings were gestational age (days) 56.28 days ±8.120, MSD was 2.2545±0.99659, YSD was 2.25±0.99, CRL was 1.29±0.66 and HR was 156.61±13.453. In a study done by suguna *et al.* [21] mean values of radiological findings were GSD 2.27 ±0.75 cm, YSD was 2.25±0.99, CRL was 1.29±0.65.

In our study we included study participants with gestational age of 6 to 10 weeks and hence the values after 10 weeks cannot be discussed. There was no significant correlation between outcomes of the pregnancy and the yolk sac size. As depicted, the yolk sac diameter of abnormal outcomes varied widely, both above and below the mean yolk sac diameter for normal outcomes, hence the mean yolk sac diameter of abnormal outcomes may not differ significantly from that of normal outcomes.

In the present study, we had 28.8% (30/104) incidence of abnormal pregnancy outcome. In the study conducted by Lindsay *et al.*, to evaluate the role of yolk sac size and shape as predictor of pregnancy outcome, the incidence of abnormal pregnancy outcome was 32.7% (159/486) [18]. Sheikh S *et al.* and Roth *et al.*, who estimated the frequency of spontaneous abortion to be 13.38% and 15% of recognizable pregnancies respectively[7,17]. In Narwal R *et al.*, the incidence of abnormal outcome was 20% which included missed abortion and blighted ova before 12 weeks of gestation [14]. But the criteria for defining an abnormal outcome varies in different studies.

In present study there is steady increase in YSD mean value and difference observed is statistically significant. According to Cepni *et al.* [20] study, a steady increase occurs in YSD from 5 to 11 weeks of gestation in normal pregnancies with disappearance of yolk sac after 12 weeks.

In a present study radiological findings observed between normal and abnormal perinatal outcome statistically significant difference were seen.

Kucuk *et al.* [19] found YSD out of 2 standard deviations of the mean for the gestational age allowed the prediction of an abnormal pregnancy outcome with a specificity of 97%, sensitivity of 65%, a positive predictive value of 71% and a negative predictive value of 95%. An abnormal yolk sac shape allowed prediction of poor outcome with a sensitivity of 29%, specificity of 95%a positive predictive value of 47% and a negative predictive value of 90.5%. They found a significant

correlation between yolk sac and gestational age, YSD and CRL, and YSD and MGSD to the level of $p < 0.001$, $p < 0.0001$ and $p < 0.0001$ respectively.

Conclusion

Yolk sac shape was a better predictor of poor pregnancy outcome in terms of higher specificity and NPV as compared to YSD. YSD/GSD ratio was also seen to have a strong association in prediction of the poor pregnancy outcome. Abnormalities of YS size or shape, early regression or absence can be used as poor predictor of first trimester pregnancy outcome, even before studying the fetal morphology. This concept may also be explored to clinical practice in embryo reduction in the era of artificial reproductive techniques.

Limitations

In our study we included participants from 6-10 weeks and outcome beyond 10 weeks could not be assessed.

Abbreviations: YSD-yolk sac diameter, MSD- mean sac diameter, HR-heart rate, CRL- crown rump length

Conflict of Interest

Not available

Financial Support

Not available

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