"YOLK SAC DIAMETER AS A PREDICTOR OF PREGNANCY OUTCOME: A PROSPECTIVE OBSERVATIONAL STUDY AT KLES DR. PRABHAKAR KORE CHARITABLE HOSPITAL AND MRC, BELAGAVI "

By

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Under the Guidance of
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LIST OF ABBREVIATIONS USED

MHz	-	Mega Heartz
Hz	-	Heartz
TVS	-	Transvaginal sonography
TAS	-	Transabdominal sonography
GA	-	Gestational age
YSD	-	Yolk sac diameter
YS	-	Yolk sac
USG	-	Ultrasonography
OPD	-	Out patient department
MRC	-	Medical Research Center
MSD	-	Mean sac diameter
CRL	-	Crown rump length
hCG	-	Human chorionic gonadotrophin
AFP	-	Alpha feto protein
NPV	-	Negative Predictive Value
PPV	-	Positive Predictive Value
PI	-	Pulsatality Index
PSV	-	Peak Systolic Velocity
RI	-	Resistance index
SD	-	Standard Deviation

ABSTRACT

Background and Objectives :

The secondary yolk sac is the first extraembryonic structure which can be detected with transvaginal sonography (TVS) in the chorionic cavity. It can be seen from the 5th to the 12th week of menstrual age. Yolk sac is the primary source of exchange between the embryo and the mother during organogenesis and before placental circulation is established. It has nutritive, endocrine, metabolic, immunologic, secretory, excretory and hematopoietic functions. This study was conducted to evaluate the secondary yolk sac diameter as a predictor of pregnancy outcome.

Methods :

In this study the data was collected from the ultrasound records of the women who were evaluated for yolk sac diameter by transvaginal sonography between 6 to 10 week 6 days of period of gestation & who were fulfilling eligible selection criteria. Total 254 women were evaluated. The yolk sac diameter was measured by placing electronic callipers at inner margins. The range of normal yolk sac diameter was considered to be 3-5 mm. While the yolk sac diameter of > 5 mm & < 3 mm were considered as abnormal. Thus two groups were made with normal & abnormal yolk sac diameter. The cases falling in these two groups were followed up to 24 wks of gestation and considered as normal pregnancy outcome if pregnancy continues beyond 24 wks with no foetal anomaly and abnormal outcome if they have spontaneous abortion, missed abortion,threatened abortion ,incomplete abortion, complete abortion, demonstrable foetal anomalies or spontaneous preterm birth.

Results :

There was a significant correlation between yolk sac diameter and the pregnancy outcome (P= 0.0001). A normal range of yolk sac diameter was considered as 3-5 mm & yolk sac diameter of >5mm & <3mm were considered as abnormal. Using these criteria of yolk sac diameter to predict pregnancy outcome, sensitivity was 50 %, specificity was 83.64 %, positive predictive value was 32.08 % and negative predictive value was 91.54 %. It was also noted that sensitivity, positive predictive value and negative predictive value were highest when the scan was performed at 8th week of gestation and specificity was highest at 9th week of gestation. . The Sensitivity & PPV were very poor at 7^{th} week of gestation.

Interpretation & Conclusion :

We can conclude from the present study that measurement of the secondary yolk sac diameter between 6th to 10th week 6 days of gestation can be used as a valuable tool to predict pregnancy outcome, even before the detection of the embryo. So that it will help in counseling the patient regarding the risk of miscarriage and the need for follow up ultrasound examinations.

Key words: Yolk Sac Diameter; Abnormal Pregnancy Outcome; Transvaginal sonography.

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INTRODUCTION

Ultrasonography is one of the most important and useful diagnostic tool in the field of modern medicine. Being noninvasive, safe and without hazards of radiation, it has gained wide acceptability, as an integral part of basic investigative procedures. The convenience, high portability, rapidity, and accuracy are few of the advantages of ultrasound over the other procedures. In the last two decades, ultrasound has become an essential diagnostic imaging modality in the field of obstetrics and is being extensively used for evaluation of pregnancy. Obstetrical ultrasound enables the clinician to evaluate the development, growth, and well-being of the fetus. The ability to study the fetus in the intrauterine environment has been notably enhanced by dramatic improvement in imaging. Although static scan imaging may compliment ultrasound studies, obstetrical examination should always be accompanied by real time modalities. Due to the inherent power of obstetrical ultrasound, if properly used, to offer to the clinician information of clinical relevance regarding the normality and the abnormalities as well of the fetal condition. As a consequence, the characteristics of the controls and management can be modulated in a more objective way. In fact the risk condition becomes only evident after ultrasound scanning because many conditions that can affect the fetus or the fetuses can be only suspected or even ignored by common clinical assessment.

Certainty of gestational age is also important in the interpretation of biochemical serum screening test results and may help to avoid undue parental anxiety from miscalculations and superfluous invasive procedures, which may increase the risk of pregnancy loss. Assessment of gestational age is also crucial for counseling patients regarding the option of pregnancy termination.

Transvaginal approach is commonly used in the first trimester. In the standard transabodominal ultrasonography lower frequencies with poorer axial resolution (ability to distinguish two separate points in the direct line of the ultrasound beam) are being used to image structures deeper in the body such as pelvic organs. The recent development of higher frequency (5 and 7.5 MHz) transvaginal transducer probe has resulted in the increased resolution of the female pelvic organs as the endovaginal probe is placed close to the pelvic organs than the transabdominal probe. With transabdominal scanning, the gestataional sac is reliably seen in the uterus by 6 weeks, and fetal echoes and cardiac activity by 7 weeks. With transvaginal scanning these are seen about one week earlier. Transabdominal scanning is used predominantly in second and third trimesters of gestation. Its use in first trimester is relatively limited and mostly diagnostic in nature. The introduction of the higher frequency transvaginal probe, with its higher resolution of images, opens new possibilities to study early gestation (Timor Tritsch) [1]

The other advantages of TVS over TAS are that there is no need for the patient to have uncomfortably full bladder and time is saved from having to wait for bladder to fill. TVS is also superior in obese patients, in patients with retroverted uterus and it also bypasses obstacles such as bone, gas filled bowel and extensive pelvic adhesions.The limitations encountered with TVS were limited manoeuribility of probe and because of the unorthodox position and angle of the transducer, correct orientation was difficult initially[2]. The transvaginal probe can utilize ultrasound frequencies of 7.0–8.0 MHz because the probe can be placed in close proximity to the organ of interest, namely the uterus. It is therefore the preferred method of pregnancy assessment in the first trimester of pregnancy.

Yolk sac

The yolk sac is one of the most important conceptional structures which is evaluated sonographically in the first trimester. Once a gestational sac is seen,the yolk sac is the first landmark to be seen within the gestational sac. The primary yolk sac forms at approximately 24 days of menstrual age. As the extraembryoniccelom forms, the primary sac is pinched off and secondary yolk sac is formed at 27-28 days of menstrual age[3]. Secondary yolk sac is the first embryonic structure visualized in gestational sac sonographically.

Structure of the Yolk Sac

At the fourth week of embryologic development, the wall of the yolk sac consists of 3 thin cellular layers (Figure 1). The outermost layer is the ectoderm, which faces the exocoelomic cavity. The ectodermal layer is in fact a distinct layer of flattened cells. However, the innermost layer facing the yolk sac cavity is the endodermal epithelium, which is composed of a single layer of cuboidal epithelial cells. Located between these two layers is the mesodermal layer,which is a very narrow tissue. This mesodermal layer consists of blood island formations in which hematopoietic stem cells can be identified throughout a primitive capillary network[4].

At this embryonic age, hematopoietic cells are also seen for the first time inside the embryonic body. These densely packed hematopoietic cells adhere to the endothelium of embryonic vessels that are surrounded by endothelial cells. Initially, the clusters of hematopoietic cells are located at the cephalic pole of the embryo, near the developing heart. By the end of the fourth gestational week, primitive blood cells are widely scattered in embryonic blood vessels located in the primordium of the

heart, mesonephros, and other embryonic organs. From the fifth gestational week onward, two compartments are clearly distinguished in the wall of the yolk sac[4].

The mesodermal compartment is formed by blood vessels and mesenchymal tissue, whereas the endodermal compartment is made up of the endodermal epithelium and endodermal vesicles or tubules. Both intraembryonic and extraembryonic blood vessels consist of primitive nucleated erythroblasts and basophilic erythroblasts. In addition, the extracellular matrix component surrounding the vessels within the yolk sac wall becomes markedly reduced. After the seventh week of embryologic development, the signs of regression begin on the wall of the yolk sac[4].

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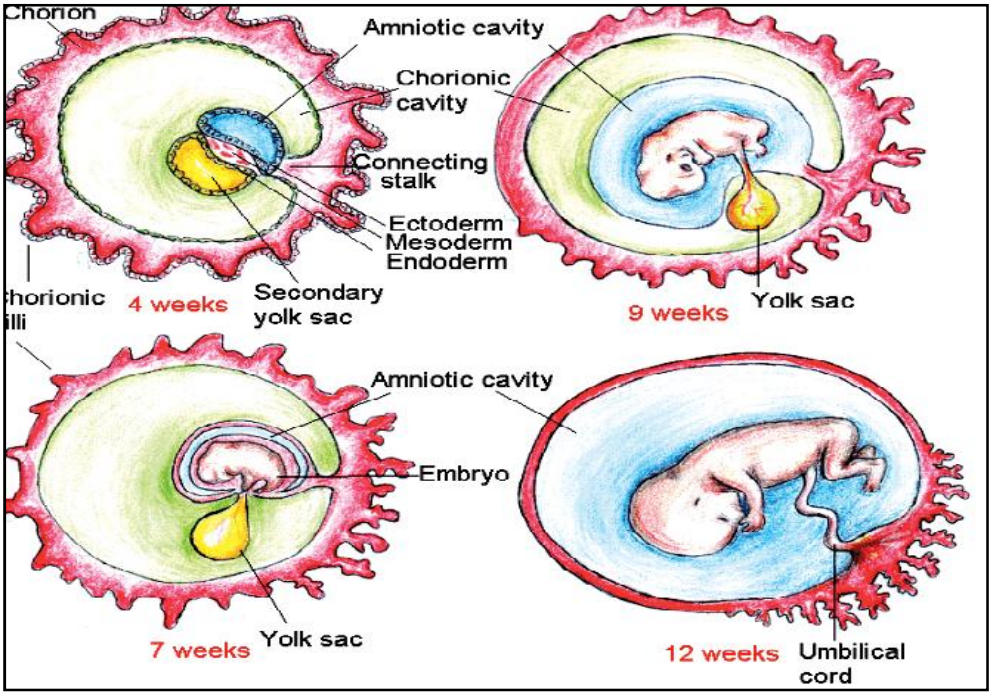


Figure 1. Diagram shows stages of the yolk sac and embryonic development

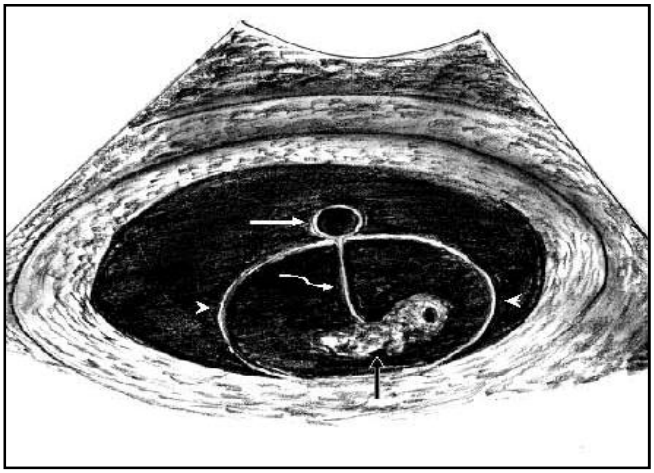


Figure 2. Normal yolk sac. A, Diagram shows a normal yolk sac (white arrow) within the gestational sac. The embryo (black arrow), amniotic membrane (arrowheads), amniotic cavity, chorionic cavity, and vitelline duct (curv arrow)

Normal Yolk Sac

A yolk sac can be detected easily by transvaginal sonography when the mean gestational sac diameter is 5 to 6 mm. Generally the yolk sac should be observed when a gestational sac measures greater than 8 mm (Figure 3). The yolk sac is situated between the amnion and the chorion. The yolk sac is connected to the embryo by the vitelline duct (Figure 2). Normally, the yolk sac appears as a circular structure with an anechoic center surrounded by a uniform well-defined echogenic wall[5] (Figure 2). Usually the inner diameter of a yolk sac measures 3 to 5 mm. The yolk sac diameter increases steadily (0.1 mm per day) until 10 weeks GA . In fact, the yolk sac size progressively increases from the beginning of the 5th gestational week to the end of the 10th gestational week. Afterward, the yolk sac size decreases gradually[6]. The number of yolk sacs present in a gestational sac can aid in determining the amnionicity of the pregnancy.

Figure 3. Gestational yolk sac. Transvaginal sonography at 5 weeks shows a yolk sac (arrow) clearly within the gestational sac. No embryo is shown.

The significance of structure of Yolk Sac

- Confirmation of intra uterine pregnancy.
- Source of exchange between mother and fetus before placental circulation is established.
- Has haematopoietic, metabolic, secretory, excretory, immunogenic function.

Most important benefit of sonographic evaluation of yolk sac at present is confirmation of intrauterine pregnancy.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. It has been studied that sonographic features of yolk sac like shape, size & internal structure of yolk sac can be associated with gestational outcome. So any gross changes in shape and size could indicate dysfunction of materno-fetal transport system and may be an indicator of impending embryonic demise[7]. So it can be used as a valuable tool of pregnancy outcome even

before embryo detection which helps in counselling patient regarding risk of miscarriage and need for follow up USG examination[8].

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. Thus further studies on the measurement of yolk sac size and its association with normal and abnormal pregnancy outcome could help as an early predictor of pregnancy outcome.

AIMS AND OBJECTIVES

The aim of this study is to assess predictive value of yolk sac diameter by transvaginal sonography with the pregnancy outcome.

REVIEW OF LITERATURE

Ultrasound examination of the fetus became integrated into prenatal care soon after its introduction in late 1950's. Transvaginal ultrasound plays an important role in first trimester prenatal evaluation. Visualization of various parameters in early pregnancy such as the MSD and CRL and their serial follow up on USG can help us in predicting the outcome of pregnancy. Various studies have been undertaken and correlation of YSD in predicting pregnancy outcome has been studied[9].

Ongoing technological advancements, including high-frequency transvaginal scanning, have allowed the resolution of ultrasound imaging in the first trimester to evolve to a level at which early fetal development can be assessed and monitored in detail.

In modern obstetrics many women present in antenatal OPD as soon as they miss their period. we are able to measure different fetal anatomical landmarks and follow their evolution during gestation by means of ultrasound scanning. Therefore, Transvaginal ultrasound has become one of the most important tools for evaluation of fetus and represents a new approach in prenatal evaluation.

Ultrasound consists of high frequency sound waves that encounter a tissue interface and are reflected,refracted, attenuated or absorbed .The real time obstetrics ultrasound examination is usually done with the patient in supine position .Sonogram gel is applied to the transabdominal or transvaginal transducer .Gel simulates a liquid interface which permits optimum travel of sound waves . The mechanical vibration required for most obstetric imaging ranges between 3-7 megahertz (MHz) million cycles per second. A transducer or ultrasound probe contains piezoelectric material

and a crystal that together generates ultrasound wave .The crystal resonates when electrical current traverses the piezoelectric ceramic.

YOLK SAC

Once a gestational sac is seen, the yolk sac is the first landmark to be seen within the gestational sac. The yolk sac is the initial source of exchange between mother and the embryo before placental circulation is established[10]. Before complete establishment of placental circulation, it has nutritional, metabolic, immunologic, endocrine, and hematopoietic functions essential in early embryonic life[10]. In the first trimester, the yolk sac is one of the most important conceptional structures that can be assessed using ultrasonography. This is actually the secondary yolk sac and it confirms an intrauterine pregnancy. The yolk sac is situated between the amnion and the chorion. The primary yolk sac form at approximately 24 days of menstrual age. As the extra embryonic celom forms, the primary yolk sac is pinched off and the secondary yolk sac is formed at 27-28 days of menstrual age, which is the first embryonic structure visualized in gestational sac sonographically[10]. The yolk sac is no longer detectable on ultrasound by the end of the first trimester.The yolk sac is first seen by transvaginal ultrasound when the mean gestational sac diameter is ≥5 mm, and should always be visualized when the mean gestational sac diameter measures greater than 1 cm[10].

The presence of the yolk sac guarantees that the visualized structure is not a pseudo-sac. With the transvaginal approach, the yolk sac should be seen by 5.5 weeks of gestational age. Like the early gestational sac, a normal yolk sac is round. It should measure less than 6 mm and have a well- defined echogenic periphery with a sonolucent center[10].

The yolk sac diameter increases steadily (0.1 mm per day) until 10 weeks GA to a maximum of 5 to 6 mm[10,11]. Yolk sac abnormalities are rather the consequence than the cause of altered embryonic development[12,13].

Gross changes in its morphology, therefore could indicate significant dysfunction of this materno-fetal transport system and may be indicator of impending embryonic demise[10].

Sonographic evaluation of the yolk sac can be beneficial in confirmation of an intrauterine pregnancy and prediction of gestational outcome through assessment of its shape, size, and internal structure[14]. With the gestational sac, it is also important to document the number of yolk sacs seen, in order to determine if a multifetal pregnancy is suspected.

Functions of the yolk sac:

Due to its structure and position, the yolk sac plays an important role in nutrition transport. The following facts support this role:

1. The wall and the cavity of the yolk sac are in direct contact with the primitive midgut.
2. Its histological structure is very similar to the liver.
3. The composition of the coelomic fluid is significantly different from the amniotic fluid: it contains proteins, creatinine, and hCG in a higher concentration[15].
4. The yolk sac synthesizes numerous proteins, which are later produced by the liver including AFP, alfa-1-antitrypsin, albumin, pre albumin and transferring.

Until the 10th post menstrual week, these factors are produced by the yolk sac and after that by the liver[16].

Circulation of the Yolk sac:

About the end of 5th week, mesoderm cells located in the visceral mesoderm of the wall of the yolk sac differentiate into blood vessels and blood cells. Centrally located cells then give rise to primitive blood cells, while those on the periphery flatten and form endothelial cells lining blood islands.

Blood islands approach each other rapidly by sprouting of endothelial cells and after fusion, give rise to small vessels. At the same time, blood vessels and capillaries develop in the extra embryonic mesoderm of the villous stems and the connecting stalk. By continuous budding, extraembryonic vessels establish contact with each other inside the embryo. Intraembryonic blood vessels, including the heart tube, are established in exactly the same manner as extraembryonic vessels.

The rhythmic contraction of the heart pumps the primitive blood from the connecting stalk towards the cranial portion of the embryo. Meanwhile, the intraembryonic blood vessels protrude into the chorion through the body stalk, and form capillary loops at the axis of the villi, giving rise to the placental circulation. The intraembryonic circulation precedes blood flow in the intervillous space.

Normal placental circulation starts only after the end of organogenesis around the 13th week, which confirms the significant role of the yolk sac in nutritive and transport functions.

Kupesic and Kurjek examined the circulation of the yolk sac and vitelline duct in early pregnancy. Before the 6th week, there is no detectable circulation in the body stalk or the yolk sac by ultrasound Doppler examination. Between the 6 and 12 weeks, there is a non continuous, low velocity waveform with absence of diastolic flow[17]. Overall visualization rate for the yolk sac vessels was 80%.

The highest visualization rates were obtained in the 7th and 8th weeks of gestation reaching values of 90%. In the same period, the visualization of the vitelline duct arteries was 87% and 91%. A characteristic waveform profile included low velocity (5.8+/-1.7 cm/s) and absence of diastolic flow which was obtained from all examined yolk sac. The pulsatility index showed the mean value of 3.24+/- 0.94. Vitelline vessels showed similar PSV (5.4 ± 1.8 cm/s) and PI values (3.14 ± 0.91)[18]

Abnormalities of the yolk sac development:

It is evident from the formation and function of the yolk sac, that any deviation in these complicated processes could disturb the development of the embryo. It plays an important role in the nutritive, metabolic and hemopoietic processes of the first trimester[19].

Absence of yolk sac is the first sonographic indicator of an early maldevelopment.

It is very important finding of a blighted ovum. In this case, we should distinguish between intrauterine and ectopic pregnancy.

Lyons established that for a gestational sac diameter of less than 10mm, the yolk sac diameter should be less than 4 mm. A large yolk sac can indicate poor

pregnancy outcome. The surviving embryos the probabilities for chromosomal aberrations increase.

Small yolk sac can also predict poor pregnancy outcome[20]. Green and Hobbins reported a similar outcome with diameter less than 2 mm[21].

Kucuk and workers found that the yolk sac diameter out of 2SD of the mean for the gestational age allowed prediction of an abnormal pregnancy outcome with a sensitivity of 65%, specificity of 97%, and positive predictive value of 71% and negative predictive value of 95%. Abnormal yolk sac shape allowed prediction of an abnormal pregnancy outcome with a sensitivity of 29%, specificity of 95%, positive predictive value of 47% and a negative predictive value of 90.5% [22].

Changes in echogenicity can also be the same predicting factors. Presence of hyperechogenic yolk sac is highly associated with chromosomal aneuploidy between the 9 and 11 gestational weeks[23].

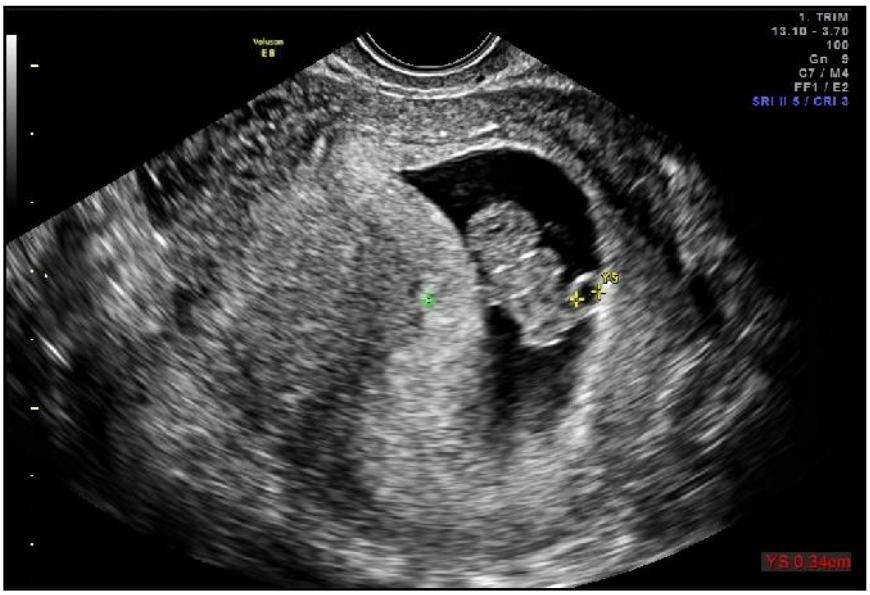


Figure 4 –Yolk Sac Diameter Measurement

Table 1. Mean diameters of yolk sac by week

Gestational age (weeks)	Sonographic diameter (mm+/-sd)
5	3.01 +/- 0.75
6	2.99 +/- 0.73
7	3.99 +/- 0.86
8	4.72 +/- 0.64
9	5.22 +/- 0.63
10	5.89 +/- 0.56
11	5.35 +/- 0.87
12	4.34 +/- 0.62

Adopted from Jauniaux E,Jurkovic D,HenrietY,etal; Development of the secondary human yolk sac;Corelationsonographic and anatomical features .HumRe

Many studies on the prognostic significance of the YS for pregnancy outcome have been performed with conventional sonography and more recently with TVS. The results are conflicting.

In a study conducted by Daniel J et al at the health sciences centre in Winnipeg, Canada it was found that a yolk sac diameter more than 2 SD above the mean when compared with the mean gestational sac diameter allowed prediction of an abnormal pregnancy outcome with sensitivity of 15.6 % and specificity of 97.4 % and

positive predictive value of 60%. Yolk sac diameter more than 2SD below the mean allowed prediction of an abnormal outcome with sensitivity of 15.5 % , specificity of 95.3% and a positive predictive value of 44.4% [10].

In another study by C.Stampone et al, a Yolk sac with abnormal size (above and below 2 standard errors of regression) was statistically significant in predicting abnormal pregnancy outcome by Fisher's exact test ($p< 0.001$) in spontaneous abortion, with a sensitivity of 68.7%, specificity of 99%, a positive predictive value of 91.6% and a negative value of 95.2% [25].

Reece, E. A., A. L. Scioscia,[26] et al reported that secondary yolk sac size does not appear to be a sensitive predictor of embryonic integrity and pregnancy outcome. In this study they had investigated the prognostic value of YS size by TAS. No significant differences in the size of this structure were found in patients with karyotype abnormalities and spontaneous abortions with respect to normal pregnancies. This is explained by the wide biological variability of the YS size found in both normal and pathological pregnancies.

Other causative factors for increased risk of miscarriage with enlarged yolk sac may include maternal metabolic disorders such as Type 1 diabetes or insulin – dependent diabetes mellitus, which are associated with an enlarged YSD[27].

It is recommended that patients at risk of poor pregnancy outcome should have a routine Trans vaginal scan before 12 weeks of gestation to assess their yolk sac and those with an abnormal yolk sac should be followed up closely to exclude fetal anomalies before 24 weeks gestation[28].

In a study , highly significant difference with value <0.001 was detected between mean YSD of pregnancy with normal outcome & missed abortions.

Abnormal yolk sac size was defined as >2SD above or below mean YSD for particular gestational age[3].

In other satudy in, YSD between 2-5 mm showed sensitivity, specificity & accuracy of 93.3 %, 83.3 % & 92.9 % for successful gestational outcome respectively. Here 34.5 % of the cases with abnormal YSD had spontaneous abortions[29].

In a latest study, all the 73 cases with yolk sac diameter 2-6mm had successful pregnancy outcome. Cases out of 22 cases with yolk sac diameter >6mm, 19 had missed abortion leaving 100% sensitivity of abnormal yolk sac diameter with poor pregnancy outcome and a p value of significant <0.001.

Thus it was concluded that yolk sac diameter at 9-10 weeks of gestation between 2-6 mm is significant to predict successful pregnancy outcome.

Yolk sac diameter >6mm is a good predictor of poor pregnancy outcome with sensitivity 100%, specificity 96.3%, PPV 86.36%, NPV 100%, accuracy 97%[30].

A study concluded that there is no difference in gestational sac diameter at 28–35 days from the last menstrual period in normal and abnormal pregnancies. However, smaller than expected sac diameter in pregnancies 36–42 days from the last menstrual period is predictive of spontaneous miscarriage[5].

In another study conducted in 193 pregnant women, YSD between 2-5 mm at 5-6.5 weeks of gestation showed statistically significant difference in abortion rates between normal & abnormal YSD range groups.(P=0.000)[31].

In a study, it was found that YSD ≥5 mm had significantly high risk of miscarriage (P=0.005)[32].In this study, out of total 305 pregnant women with gestational age of 6-9 weeks, 37.5% had miscarriage. The other characteristics of yolk sac like regular or irregular shape was also studied where they did not find any difference between the risk of miscarriage among both groups[32].

In a latest study which was conducted in 72 pregnant women of 6-12 weeks of gestation showed highly significant correlation between yolk sac size & pregnancy outcome (P<0.001).In this study the mean YSD was 3.7±1.8 mm. The cases where yolk sac was either enlarged or small resulted in Abortions[33].

METHODOLOGY

The present study was conducted in the Department of Obstetrics and Gynaecology, K.L.E.S. Dr. Prabhakar Kore charitable Hospital and Medical Research Centre, Belagavi during the period of January 2015 to February 2016.

Source of Data

Records of pregnant women registering between 6 to 10 week 6 days period of gestation in OPD at KLES Dr. Prabhakar Kore Charitable Hospital and Medical Research Centre, Belagavi and who were fulfilling eligible selection criteria were studied prospectively.

Study design

The study design was a hospital based prospective observational study.

Study Period

The present study was conducted from January 2015 to February 2016.

Place of study

This study was conducted in the department of Obstetrics and Gynaecology, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi a teaching hospital attached to Jawaharlal Nehru Medical College, Belagavi.

Sample Size and sampling procedure

The sample size was taken as the number of all pregnant women undergoing for the ultrasound with the documentation of yolk sac during 6 week- 10 weeks 6 days of gestation & fulfilling inclusion criteria from January 2015 to February 2016.

Selection Criteria

Inclusion criteria

- Records of pregnant women registering at KLES Dr. Prabhakar Kore Charitable Hospital and MRC, Belagavi.
- Gestational age between 6 week-10week 6days with ultrasound documentation of yolk sac.

Exclusion Criteria

- Molar pregnancy
- Blighted ovum.
- Ectopic pregnancy
- Women with congenital anomalies of uterus and cervix
- Multiple gestation
- Women with known endocrine disorder causing abnormal pregnancy outcome e.g. hypothyroidism, diabetes mellitus.

Ethical clearance

The study was approved by the Institutional Ethics Committee of Jawaharlal Nehru Medical College, Belagavi.

Consent form

Consent was not taken as the data was collected from the records of ultrasound, OPD & labour room.

Data collection

The findings were noted from the ultrasound records of the women who were evaluated for yolk sac diameter by transvaginal sonography between 6 to 10 week 6 days of period of gestation & who were fulfilling eligible selection criteria. Data regarding age, obstetric history and period of gestation of these cases were also noted from the OPD records.

Method of collection of data

The data was collected from the ultrasound records of the women who were evaluated for yolk sac diameter by transvaginal sonography between 6 to 10 week 6 days of period of gestation & who were fulfilling eligible selection criteria.

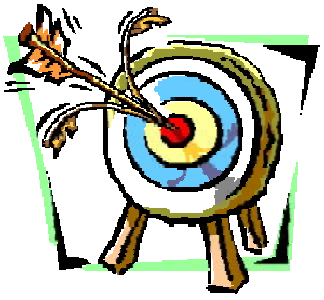
Ultrasound was performed by selected trained obstetric sonologists. A 9Hz transducer of Phillips HD 11 Ultrasound scan machine was used to perform the scan. Head of the probe was cleaned & covered with a sterile condom. Tip of the condom was smeared with ultrasonic jelly for smooth insertion into the vagina.

The sonography was done with the empty bladder. 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 yolk sac was identified & its diameter was measured by placing electronic callipers at inner margins. The range of normal yolk sac diameter was considered to be 3-5 mm. While the yolk sac diameter of > 5 mm & < 3 mm were considered as abnormal. Thus two groups were made with normal & abnormal yolk sac diameter.

The cases falling in these two groups were followed up to 24 wks of gestation and considered as normal pregnancy outcome if pregnancy continues beyond 24 wks with no foetal anomaly and abnormal outcome if they have spontaneous abortion, missed abortion,threatened abortion ,incomplete abortion, complete abortion, demonstrable foetal anomalies or spontaneous preterm birth.

Introduction



Objectives

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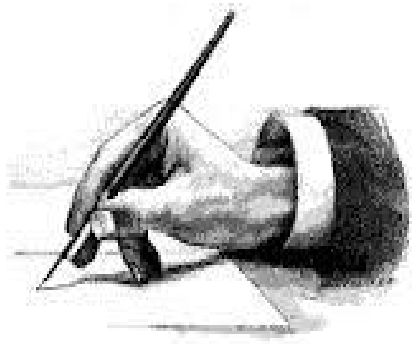
Results

Discussion

Conclusion

Summary

Bibliography



Annexure-I

Annexure-II

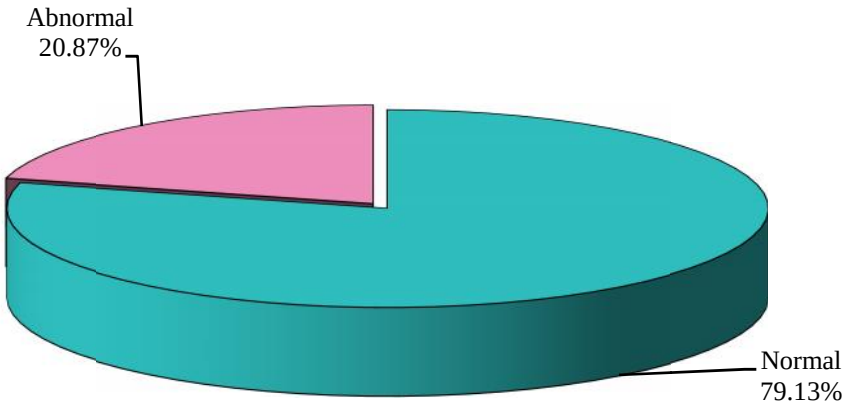
Annexure-III

RESULTS

Table 2: Yolk sac diameter in study population

Yolk sac diameter (YSD)	Number (n)	Percentage
Normal	201	79.13
Abnormal	53	20.87
Total	254	100.00

Graph 1 :Yolk sac diameter in study population

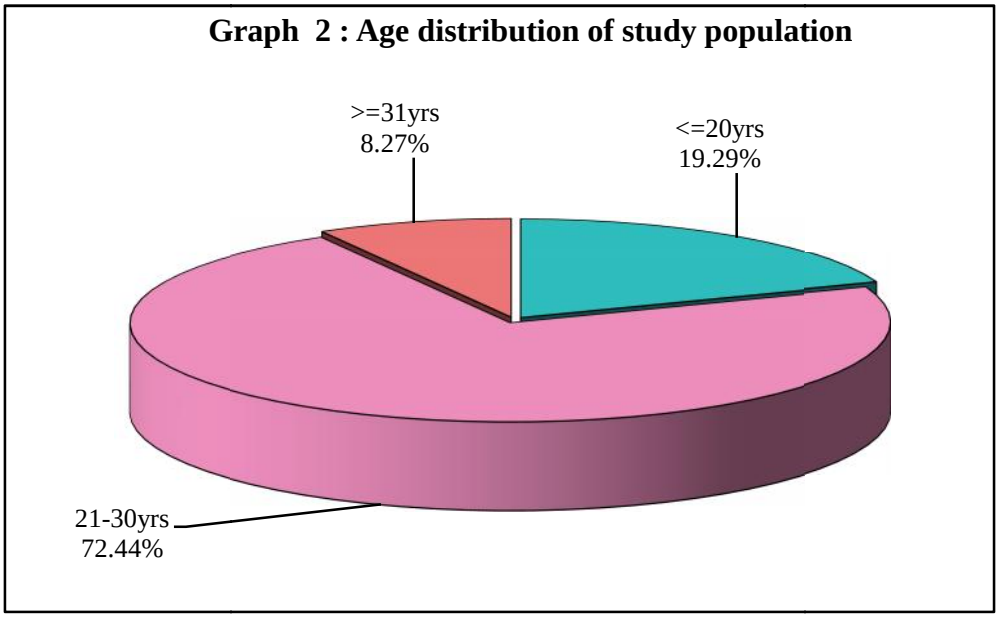


In the present study, majority of the cases were with normal yolk sac diameter (YSD) i.e around 201 cases which accounts for 79.13 % of total study population & total number of cases with abnormal yolk sac diameter (YSD) were 53 which accounts for 20.87% of total study population.

Table 3: Age distribution of study population

Age groups	Number (n)	Percentage
<=20yrs	49	19.29
21-30yrs	184	72.44
>=31yrs	21	8.27
Total	254	100.00
Mean age	**23.94**	
SD age	**03**	

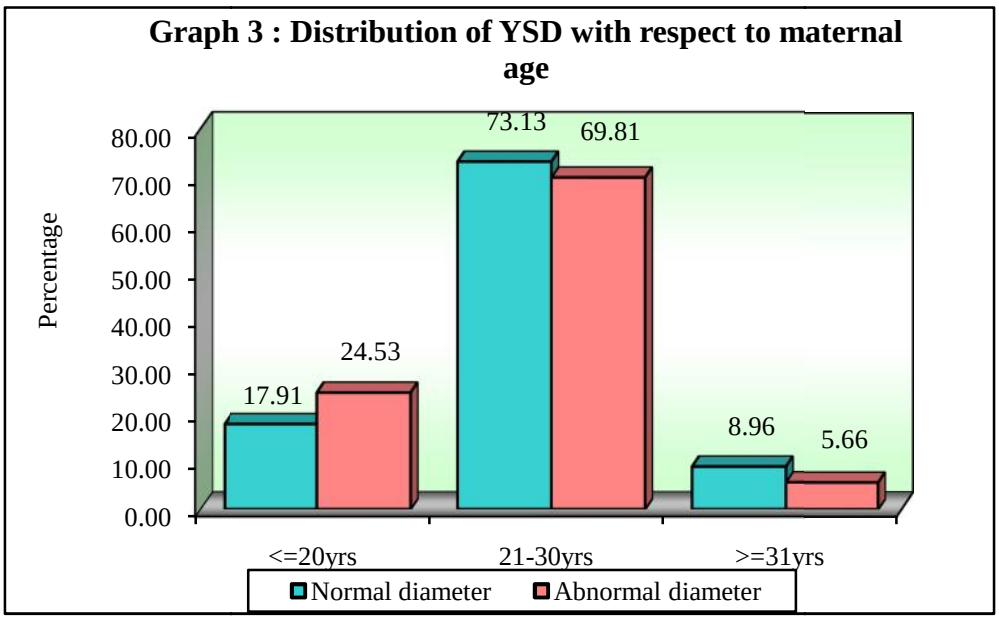
Graph 2 : Age distribution of study population



In this study, 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 184 cases belong to 21 to 30 years age group which accounts for 72.44 % of total studypopulation and 21 cases i.e 8.27 % of total study population were from 31 years or more than 31 years age group.

Table 4 : Distribution of YSD with respect to maternal age

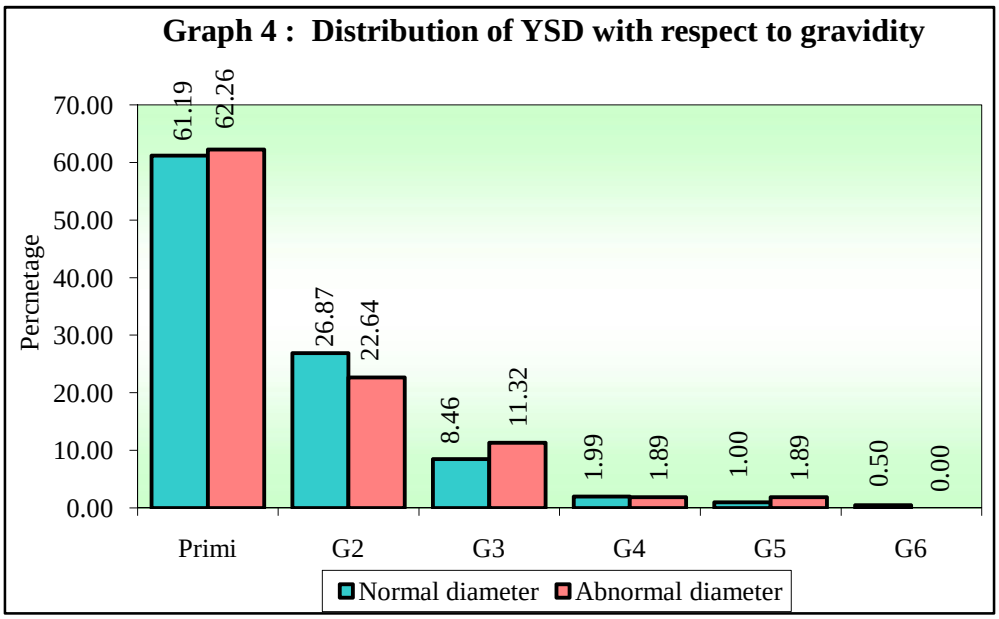
Maternal age	Normal diameter	%	Abnormal diameter	%	Total (n)	%
<=20yrs (n-=49)	36	17.91	13	24.53	49	19.29
21-30yrs (n=184)	147	73.13	37	69.81	184	72.44
>=31yrs (n=21)	18	8.96	3	5.66	21	8.27
Total (n=254)	201	100.00	53	100.00	254	100.00
Chi-square=1.5672 P = 0.4572						



In table 5, from age group of ≤ 20 years, 36 cases were having normal diameter while 13 cases were having abnormal diameter. In age group of 21-30 years, 147 cases were having normal diameter while 37 cases were having abnormal diameter. 18 cases from the age group of ≥ 31 years were having normal diameter while 3 cases were having abnormal diameter from the same age group. Here P value was 0.4572 i.e not significant which shows that age has no impact on YSD.

Table 5 : Distribution of YSD with respect to gravidity

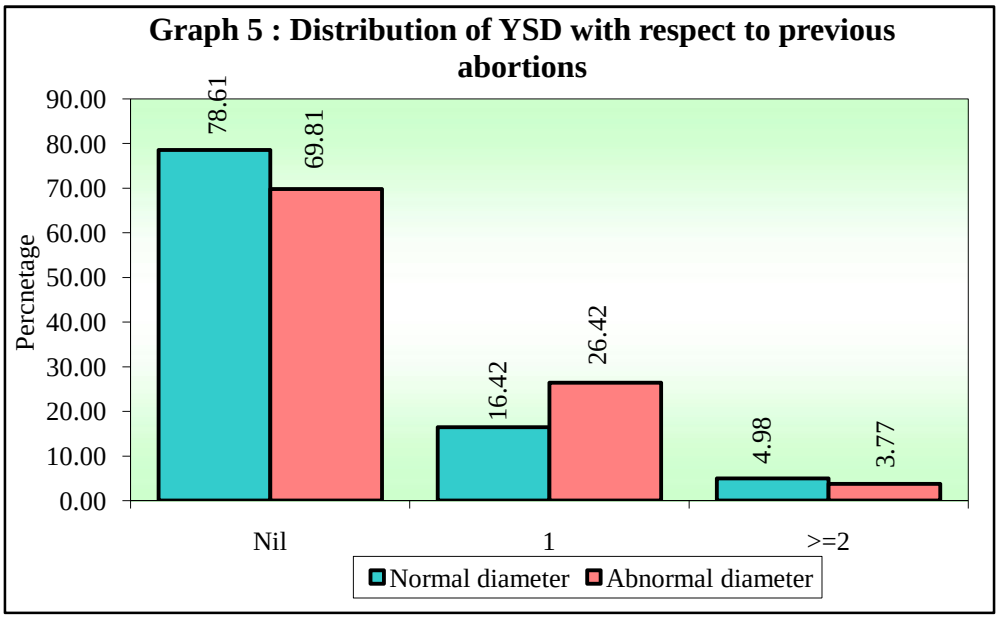
Gravidity	Normal diameter	%	Abnormal diameter	%	Total (n)	%
Primi (n=156)	123	61.19	33	62.26	156	61.42
G2 (n-=66)	54	26.87	12	22.64	66	25.98
G3 (n=23)	17	8.46	6	11.32	23	9.06
G4 (n=5)	4	1.99	1	1.89	5	1.97
G5 (n=3)	2	1.00	1	1.89	3	1.18
G6 (n=1)	1	0.50	0	0.00	1	0.39
Total (n=254)	201	100.00	53	100.00	254	100.00
Chi-square= 4.4824 P = 0.3441						



In this study, majority of cases i.e 156 cases were primigravidas (around 61.19 % of total study population) out of which 123 cases were with normal YSD & 33 cases were with abnormal YSD. 66 cases were second gravida out of which 54 cases were with normal YSD & 12 cases were with abnormal YSD. Total 3rd gravida cases were 23 out of which 17 cases were with normal YSD & 6 cases were with abnormal YSD. 5 & 3 cases belong to gravida 3 & 4 respectively. Only 1 case was 6th gravida who was having normal YSD. Here P value was 0.3441 which is not significant ; suggesting gravidity also has no impact on YSD.

Table 6 : Distribution of YSD with respect to previous abortions

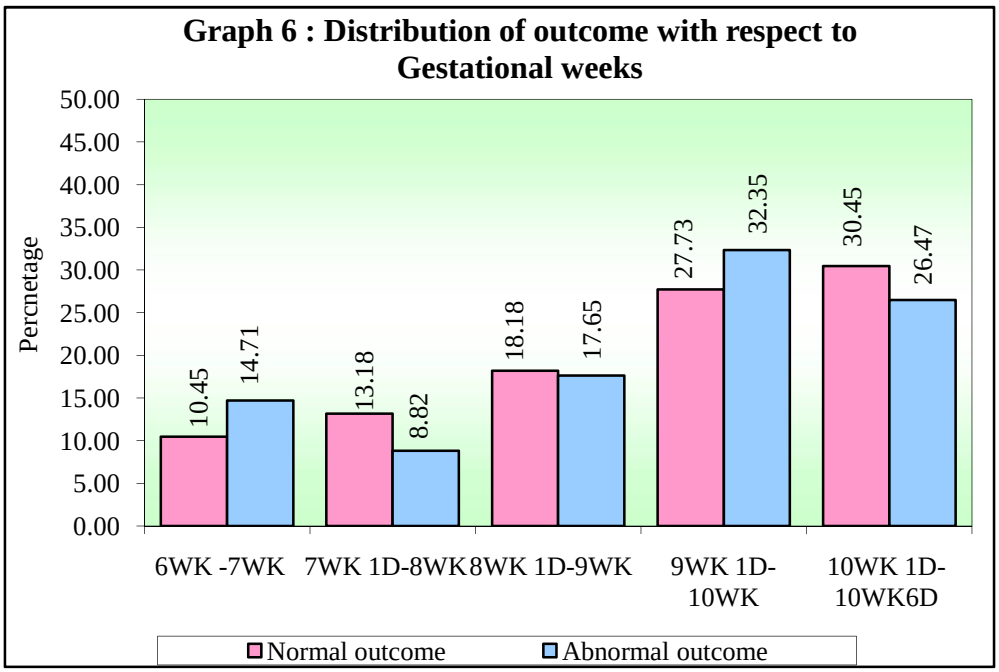
Previous abortions	Normal diameter	%	Abnormal diameter	%	Total (n)	%
Nil (n=195)	158	78.61	37	69.81	195	76.77
1 (n=47)	33	16.42	14	26.42	47	18.50
>=2 (n=12)	10	4.98	2	3.77	12	4.72
Total (n=254)	201	100.00	53	100.00	254	100.00
Chi-square= 2.8162 P = 0.2456						



Here total 195 cases were seen with previous nil abortion i.e 76.77 % of total study population. Total cases with previous 1 abortion were 47; out of which 33 cases were having normal YSD & 14 cases were having abnormal YSD. While total 12 cases were seen with previous 2 or more abortions; out of which 10 cases were having normal YSD & 2 cases were having abnormal YSD. The P value was 0.2456 which is not significant; suggesting history of previous abortions has no association with YSD in present pregnancy.

Table 7 : Distribution of outcome with respect to Gestational weeks

Gestational Weeks	Normal outcome	%	Abnormal outcome	%	Total (n)	%
6WK-6WK6D (n=28)	23	10.46	5	14.71	28	11.02
7WK 1D-8WK (n=32)	29	13.18	3	8.82	32	12.60
8WK 1D-9WK (n=46)	40	18.18	6	17.65	46	18.11
9WK 1D-10WK (n=72)	61	27.73	11	32.35	72	28.35
10WK 1D-10WK6D (n=76)	67	30.45	9	26.47	76	29.92
Total (n=254)	220	100	34	100	254	100
Chi-square= 1.3101			**P = 0.8602**			

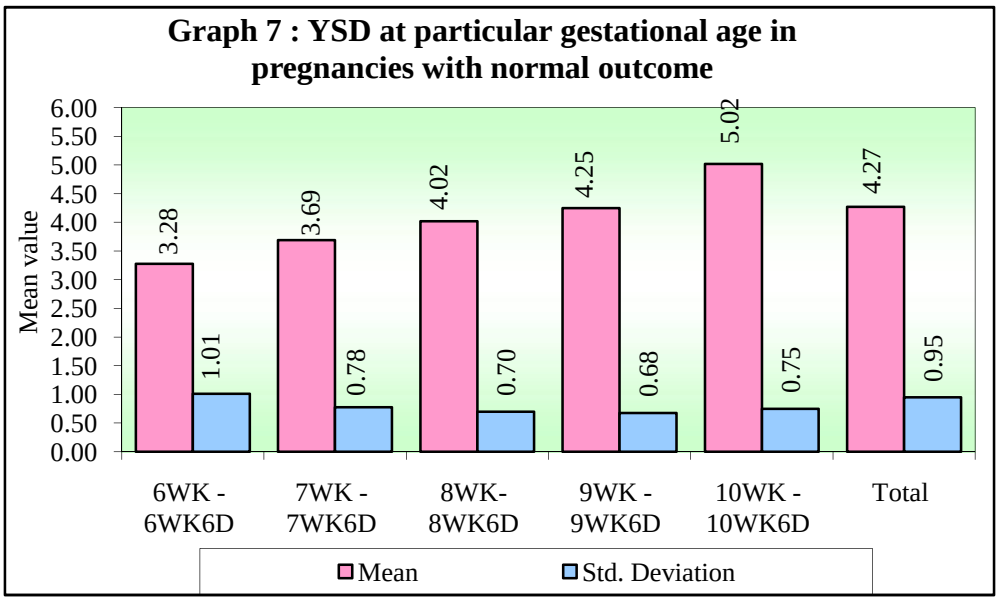


In this study, total 28 cases were present in 6 wks to 6 wk 6 days group; out of which 23 cases had normal outcome & 5 cases had abnormal outcome. In 7 wks to 7wk 6 days group, total 32 cases were there which included 29 cases with normal outcome & 3 cases with abnormal outcome. In next group of 8wks to 8wk6days, out of total 46 cases, 40 cases had normal outcome & 6 cases had abnormal outcome. The maximum number of cases with abnormal outcome were from 9 wks to 9wk 6 days group i.e around 11 cases & 61 cases were having normal outcome in the same group. The last group of 10 wks to 10wk 6 days was having maximum number of cases of totalstudy population i.e 76 cases where 67 cases were falling in normal outcome group & remaining 9 cases in abnormal outcome group.

The P value was 0.8602; suggesting that there is no significant difference between normal & abnormal outcome with respect to gestational age.

Table 8 : YSD at particular gestational age in pregnancies with normal outcome

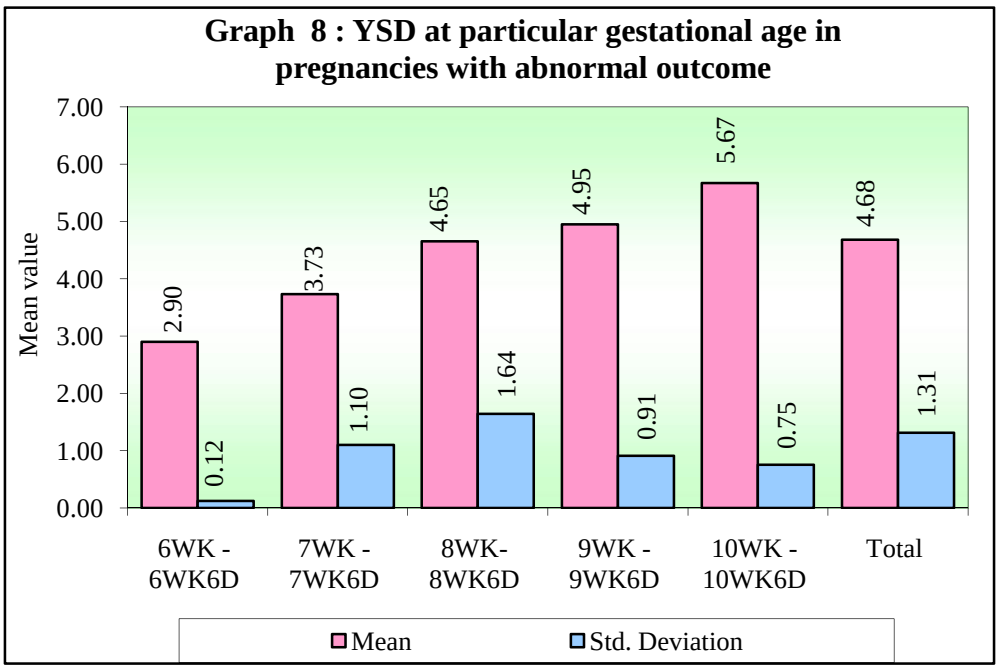
Gestational weeks	Number (n)	Minimum	Maximum	Mean	Std. Deviation
6WK -6WK6D	23	2.00	6.00	3.28	1.01
7WK -7WK6D	29	3.00	6.00	3.69	0.78
8WK-8WK6D	40	3.00	7.00	4.02	0.70
9WK -9WK6D	61	2.00	6.00	4.25	0.68
10WK -10WK6D	67	2.70	7.00	5.02	0.75
F= 31.3351			**P=0.0001***		



In this table, total number of cases with normal outcome were 23 in the gestational age group of 6 wks- 6wks 6 days. The minimum diameter in this particular gestational age group was 2 mm & the maximum diameter was 6 mm. While the mean diameter here was 3.28 mm. The standard deviation for this group was 1.01 which was more than other gestational age groups. For the subsequent gestational age groups, the mean diameter was 3.69 mm,4.02 mm, 4.25 mm & 5.02 mm respectively. The minimum & maximum diameter in total normal outcame cases were 2 mm & 7 mm respectively while the mean diameter of total cases was 4.27 mm with the standard deviation of 0.95. The P value was 0.0001 which is significant.

Table 9 : YSD at particular gestational age in pregnancies with abnormal outcome

Gestational weeks	Number (n)	Minimum	Maximum	Mean	Std. Deviation
6WK -6WK6D	5	2.70	3.00	2.90	0.12
7WK -7WK6D	3	3.00	5.00	3.73	1.10
8WK-8WK6D	6	2.00	6.00	4.65	1.64
9WK -9WK6D	11	4.00	6.00	4.95	0.91
10WK -10WK6D	9	5.00	7.30	5.67	0.75
F= 7.0980			**p=0.0004***		



In this table, out of total 5 cases from 6 wks to 6wk 6 days group, the minimum diameter was 2.70 & maximum diameter was 3 mm. Here the mean diameter was 2.90 mm & standard deviation was 0.12. The mean diameter for the subsequent groups were 3.73 mm, 4.65 mm, 4.95mm & 5.67 mm respectively. The standard deviation was more than other groups in the 8wks – 8wk 6days group i.e1.64. The minimum & maximum diameter were 2 mm & 7.3 mm respectively in total abnormal outcome cases with the mean diameter of 4.68 mm. Here the P value was 0.0004 which is significant.

Table 10- Abnormal outcomes in details :

Gestational age group	Gestational age	YSD	Outcome	History of previous abortion
6 week-6week 6days	6 wk	2.9 mm	Spontaneous abortion at 9wk 6days	Present
	6wk 2 days	2.9 mm	Spontaneous abortion at 9 wk	Present
	6wk 4 days	2.7 mm	Spontaneous abortion at 10wk 5days	Not present
	6wk 1 day	3 mm	Incomplete abortion at 10wk	Present
	6 wk 3 day	3 mm	Missed abortion at 13wk2days	Not present
7 week-7week 6 days	7wk 2 days	3 mm	Complete abortion at 12wks	Present
	7 wk 2 days	5 mm	Complete abortion at 11wk1day	Not present
	7 wk 2 days	3.2 mm	Missed abortion at 11wk6days	Not present
8week-8week6days	8 wk	3.9 mm	Complete abortion at 10wk	Not present
	8 wk 6days	4 mm	Preterm delivery at 23wk1day	Not present
	8wk 5days	6 mm	Complete abortion at 11wk	Present
	8wk 1 day	6 mm	Missed abortion at 11wk6days	Not present
	8wk3days	2 mm	Complete abortion at 10wk6days	Present
	8wk 2days	6 mm	Missed abortion at 12wk	Present
9week-9week 6days	9wk 6days	4.5 mm	Incomplete abortion at 12wk5days	Present
	9wk3days	5 mm	Complete abortion at 12 wk	Present
	9wk2days	4 mm	Complete abortion at 14wk	Present
	9week	5 mm	Preterm delivery at 22wk	Not present
	9wk 5days	6 mm	Preterm delivery at 22wk 4days	Present
	9wk3days	6 mm	Preterm delivery at 23wk3days	Not present
	9wk6days	6 mm	Complete abortion at 14wk6days	Not present
	9wk2days	4 mm	Incomplete abortion at 13wk 5days	Not present
	9wk3days	4 mm	Complete abortion at 11wk1day	Not present
	9wk6days	6 mm	Incomplete abortion at 12wk6days	Not present
	9wk4days	4 mm	Missed abortion at 13wk	Not present
	10wk2days	5.3 mm	Incomplete abortion at 17wk	Present

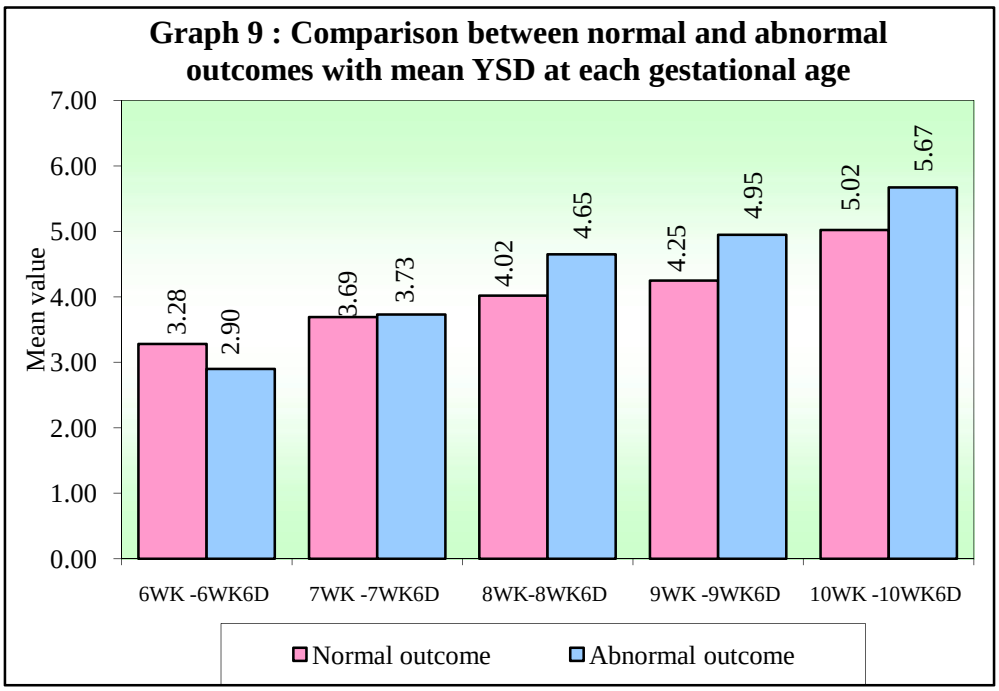
10week-10week6days	10week	4.5 mm	Missed abortion at 14wk5days	Not present
	10wk3days	5 mm	Complete abortion at 17wk3days	Present
	10wk2days	5 mm	Complete abortion at 18wk1day	Present
	10wk6days	6 mm	Spontaneous abortion at 12wk	Not present
	10wk4days	6 mm	Spontaneous abortion at 11wk3days	Not present
	10wk	5.4 mm	Preterm delivery at 22wk4days	Present
	10wk6days	6 mm	Incomplete abortion at 15wk6days	Not present
	10wk4days	7.3 mm	Incomplete abortion at 13wk4days	Not present

This table shows all 34 cases of abnormal outcome; out of which 17 cases had abnormal YSD & 17 cases had normal YSD. 10 cases had YSD of 6 mm which had abnormal outcomes; of which 8 cases had abortions (2 cases had missed abortions,2 cases had spontaneous complete abortions, 2 cases had threatened abortions which resulted in complete abortion at the end & 2 cases had incomplete abortions) & 2 cases had pre term deliveries. One case with YSD of 7.3 mm had incomplete abortion. Two cases had YSD more than 5 mm; of which one case had incomplete abortion & other case had pre term delivery. Remaining 4 cases had YSD less than 3 mm; all of which had spontaneous abortions.

This table also shows relation of previous abortion with abnormal outcomes. Here 13 cases (38.23%) with previous abortion history (13/34) had recurrent abortion in present pregnancy also while 2 cases with previous abortion history had preterm deliveries in present pregnancy.

Table 11 : Comparison between normal and abnormal outcomes with mean YSD at each gestational age

Gestational weeks	Normal outcome		Abnormal outcome		t-value	p-value
	Mean	SD	Mean	SD		
6WK - 6WK6D	3.28	1.01	2.90	0.12	0.8325	0.4127
7WK - 7WK6D	3.69	0.78	3.73	1.10	--0.0824	0.9349
8WK- 8WK6D	4.01	0.70	4.65	1.64	--1.6798	0.1001
9WK - 9WK6D	4.24	0.68	4.95	0.91	--3.0117	0.0036*
10WK - 10WK6D	5.02	0.75	5.66	0.75	--2.4234	0.0178*



Here the mean diameters of both normal & abnormal outcomes are compared in each particular gestational age group. The P value is significant only for two groups i.e 9wks- 9wk 6days & 10 wks-10 wk6days group which shows that YSD has significant association with the pregnancy outcome during this particular gestational age.

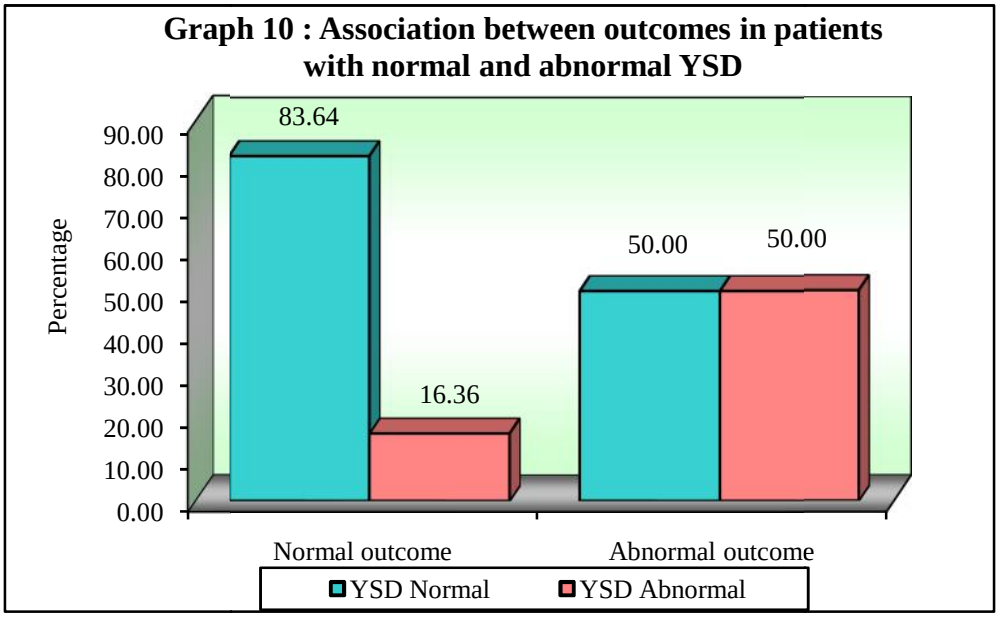
Table 12 : Outcomes in patients with normal and abnormal YSD based on gestational age

Gestational weeks	YSD	Normal outcome	Abnormal outcome	Total	P-value
6WK-6WK6D (n=28)	Normal	18	2	20	0.2420
	Abnormal	5	3	8	
7WK-7WK6D (n=32)	Normal	27	3	30	1.0000
	Abnormal	2	0	2	
8WK-8WK6D (n=46)	Normal	38	2	40	0.00001*
	Abnormal	2	4	6	
9WK-9WK6D (n=72)	Normal	58	7	65	0.0070*
	Abnormal	3	4	7	
10WK-10WK6D (n=76)	Normal	43	3	46	0.1574
	Abnormal	24	6	30	
Total (n=254)	Normal	184	17	201	0.0001*
	Abnormal	36	17	53	

Here, pregnancy outcomes are compared with YSD in each particular gestational age group. The P value was significant in 8wks- 8 wk 6 days group & in 9 wks-9 wk 6 days group which was around 0.00001 & 0.0070 respectively; suggesting that YSD is more valuable tool in predicting pregnancy outcome during this particular gestational age groups.

Table 13 : Association between outcomes in patients with normal and abnormal YSD

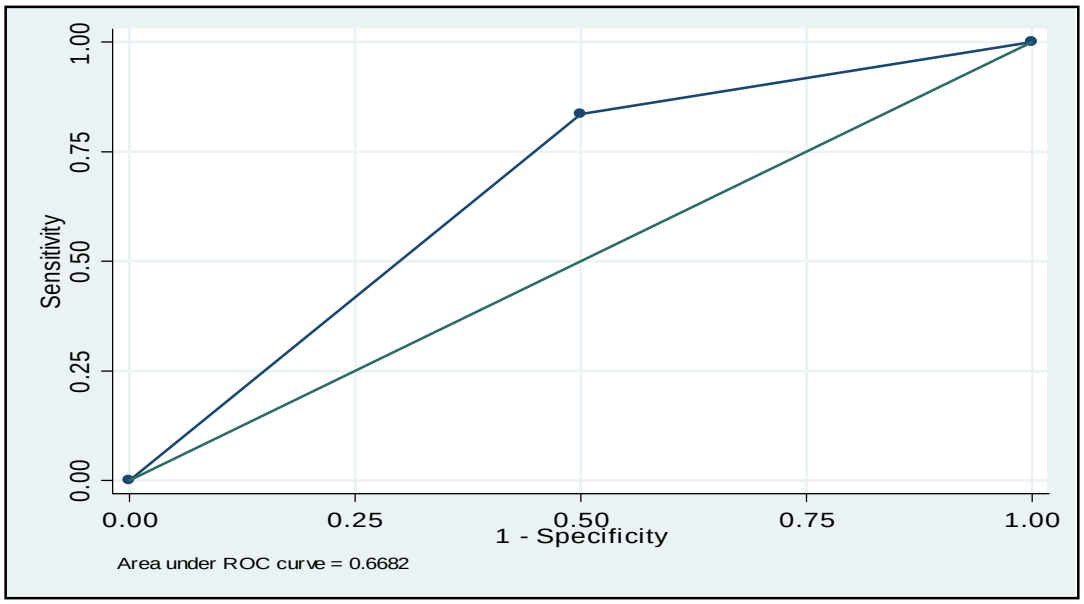
YSD	Normal outcome	%	Abnormal outcome	%
Normal (n=201)	184	83.64	17	50.00
Abnormal (n=53)	36	16.36	17	50.00
Total (n=254)	220	100.00	34	100.00
Chi-square=20.1728 P = 0.0001*				



In this study, total number of cases with normal outcome were 220. Out of which, 184 cases were having normal YSD i.e 83.64 % of total normal outcome cases. While 36 cases were with abnormal YSD i.e 16.36 % of total normal outcome cases. Total cases with abnormal outcome were 34 ; out of which 17 cases belong to

each normal and abnormal YSD groups. Here, P value is 0.0001 which is significant; suggestive of YSD has significant effect on pregnancy outcome.

Graph 11 : Area under the curve



This is the graph showing area under the curve; which is here around 0.6682. It means around 66.82 % of total cases of study population fall under this curve which is nothing but the accuracy of this study.

Table 14: Yolk sac as a predictor of pregnancy outcome

Gestational weeks	Sensitivity	Specificity	PPV	NPV
6WK -6WK6D	60.00	78.26	37.50	90.00
7WK -7WK6D	0.00	93.10	0.00	90.00
8WK-8WK6D	66.67	95.00	66.67	95.00
9WK -9WK6D	36.36	95.08	57.14	89.23
10WK -10WK6D	66.67	64.18	20.00	93.48
TOTAL	50.00	83.64	32.08	91.54

In this table, sensitivity was more i.e 66.67 % for 8wks- 8wk6days group & 10wks- 10wk6days group. The sensitivity & PPV was not good for 7wk- 7wk6days group. The specificity was high in 9 wk-9wk 6days group which was 95.08 %. Among all gestational age groups, the sensitivity, specificity, PPV & NPV was high for 8 wk- 8wk6days 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 & specificity of YSD was 50 % & 83.64 % in this study.

Table 15: Comparison of outcome with mean of different variables by t test

Variable	Normal		Abnormal		Total		t-value	p-value
	Mean	SD	Mean	SD	Mean	SD		
Yolk sac diameter (YSD)	4.27	0.95	4.68	1.31	4.32	1.01	-2.2383	0.0261*

Here the mean diameter of total cases with normal outcome is compared with the mean diameter of total cases with abnormal outcome. The P value is 0.0261 which is significant; showing that YSD has a role in predicting pregnancy outcome.

DISCUSSION

The reliability of ultrasonographic visualization of the human yolk sac is well established[34].

In our study, 254 pregnancies were analyzed between 6 to 10 weeks 6 days period of gestation to determine the role of yolk sac diameter as a predictor of pregnancy outcome. This sample size was larger than that of the study[35], where a sample size was 117.

But the sample size in the our study is much smaller than the study conducted in Winnipeg, Canada[36], where 486 consecutive intrauterine pregnancies were examined.

In our study, the mean YSD was progressively increasing with advancing gestational age from 6weeks to 10 weeks 6 days (Table 11). In a study[37] it was demonstrated that there is a steady increase in YSD from 5 to 11 weeks of gestation in normal pregnancies after which it disappears by 12 weeks. Also other study[28] reported a linear increament in mean YSD from 2.27 mm at 5 weeks of gestation to 5.61 mm at 11 weeks of gestation. In a study[10] it was reported that yolk sac grows at a rate of approximately 0.1 mm per mm growth of the MSD when the MSD is less than 15 mm and then slows to 0.03 mm per mm growth of MSD.

Our finding was also comparable to the Indian study[7] 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.

The mean age in our study was 23.94 ± 3 (as shown in table 3). There was no significant association between YSD & maternal age in our study (P value = 0.452). (Table 4)

In the study conducted in Iran, the mean age of the study group was 28.1 ± 5.8 years and that of the control group was 28 ± 4.8 years, which was not statistically significant (p=0.876)[31]. Also in the another study by in India, there were no significant differences between outcomes with regard to maternal age[38]. In our study, the probability of abnormal pregnancy outcome did not vary with maternal age.

This is contradictory to the results of previous studies which show an increase in the incidence of miscarriage with increase in maternal age[39,40,41]. According to these studies, until age 30, the incidence of miscarriage is approximately 12%, thereafter the rate increases rapidly, exceeding 50% in the women older than 45 years[41].

In our study, the comparison between YSD & gravidity was also made(as shown in table 5), where the P value was not significant (P = 0.3441). In one study in India, there were no significant differences between outcomes with regard to gravidity[38]. So, this finding of the gravidity having no correlation with the YSD was seen in the our study also.

In a recent study in India, it was found that the history of previous abortions has significant correlation with the abortion in present pregnancy (P value = 0.040)[30]. While in our study, YSD was compared with the previous abortion where we got P value of 0.2456 which was not significant as shown in table 6.In our study among all 34 cases with abnormal outcome, total 15 cases had history of previous abortions. Out

of these 15 cases, 13 cases (38.23%) had recurrent abortion in present pregnancy & 2 cases had preterm deliveries in present pregnancy.

In our study, among all abnormal outcome cases, the smallest diameter was 2 mm which was found in 8 weeks group & the largest diameter was 7.3 mm found in 10 weeks group as depicted in table 9. Thus in our study the largest diameter was less than that found in the study conducted in Iran, where they found 9.2 mm as the largest diameter which resulted in abortion[31]. Also in one more study in India, the diameter of the smallest yolk sac was 1.25 mm and that of the largest was 8.96 mm & both the cases resulted in abortions[33]. Another study in Turkey, had one case where the largest YSD was 6.1 mm & it resulted in first trimester miscarriage. Two more studies concluded that smaller YSD than expected for any gestational age is a predictor of poor pregnancy outcome in first trimester[43,44]. Thus our finding of abnormal diameter resulting in abnormal outcome was in accordance with all above these studies.

In contrast, smallest diameter of 2 mm & largest diameter of 7 mm were also found in the normal outcome group in our study (as shown in table 8) which was in accordance with the findings of one study where it was mentioned the existence of a very large YSD (8.1 mm) in a normal live pregnancy[45]. Also the findings of other two studies reported that 28.57% and 66.25% of the cases, which had enlarged yolk sac terminated into normal outcome respectively[22,46].Thus this finding was comparable to our study.

In a recent study in India, the mean YSD was noted as 3.7±1.8 mm & the diameter of the smallest yolk sac was 1.25 mm and that of the largest was 8.96 mm[33]. In our study, the mean YSD was 4.32± 1.01 mm as shown in table 15; while the smallest YSD was 2 mm & the largest YSD was 7.3 mm as shown in table 9.

In the study conducted in Turkey, the mean YSD was 3.2 ± 0.7 mm[32]. So in our study, the mean YSD was more than these other two studies & the largest YSD was comparatively lesser in our study than that of recent study conducted in India[33].

As depicted in table 8, 9 and 11, 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. This is contradictory to the Indian study[3] in which a highly significant difference was detected between mean YSD of both groups ($P<0.001$).

In our study, 10 cases had YSD of 6 mm which had abnormal outcomes; of which 8 cases had abortions (2 cases had missed abortions,2 cases had spontaneous complete abortions, 2 cases had threatened abortions which resulted in complete abortion at the end & 2 cases had incomplete abortions) & 2 cases had pre term deliveries. One case was having largest YSD of 7.3 mm in our study group which resulted in incomplete abortion. Two cases had YSD more than 5 mm; of which one case had incomplete abortion & other case had pre term delivery. Remaining 4 cases had YSD less than 3 mm; all of which resulted in spontaneous abortions.

Thus our study found that increased YSD may result into pre term delivery which was comparable to the finding of one more study.[46]

In our study, when the association between outcomes in pregnancies with normal & abnormal YSD was studied, the P value was highly significant ($p=0.0001$) as shown in table 12; which was in accordance with the other study[30], where p value was < 0.001 & also with one more study[47] where p value was < 0.001.

In our study, total cases with the abnormal outcome were 34 (as per table 13). Out of these cases, 17 cases (50%) had abnormal YSD & 17 cases (50%) had normal YSD. In these 17 cases with abnormal YSD, 13 cases (76.5%) had YSD more than 5 mm & 4 cases (23.5%) had YSD less than 3 mm.

In a study conducted[46], the authors have examined the value of a specific cut-off (5 mm) to allow easier patient counselling. They concluded pregnancies with MSD≥ 5 mm on early ultrasound require monitoring and counselling 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. In addition, their study shows for the first time that enlarged yolk sac diameter may be associated with an increased risk of preterm delivery.

In a study[36] it was reported that no pregnancy with normal outcome had a yolk sac diameter of greater than 5.6 mm at less than 10 weeks of menstrual age. In 6 patients the yolk sac diameter was more than 5.6 mm. All 6 had abnormal outcome.

In our study, we had 13.38 % incidence (34/254) of abnormal pregnancy outcome out of which 17 cases (50%) had abnormal YSD. This is in concordance with the study [47] where it was estimated that the frequency of spontaneous abortion to be 15% of recognizable pregnancies. In one more study[36], 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). But the criteria for defining an abnormal outcome varies in different studies, for example in our study, abnormal outcome was defined as spontaneous abortion, or missed abortion before 24 weeks of gestation or demonstrable foetal anomalies whereas, the above mentioned study[36] considered

abnormal outcome as first trimester embryonic or fetal death or demonstrable fetal anomaly.

In an Indian study[3], the incidence of abnormal outcome was 20% which included missed abortion and blighted ova before 12 weeks of gestation.

In our study, we analysed the pregnancy outcome depending upon normal & abnormal YSD. The pregnancy outcome was optimum when YSD was normal. The pregnancies which continued beyond 24 weeks were 91.54 % in this group (184/201) (as shown in table 13). However when the YSD was abnormal, the normal pregnancy outcome rate was significantly decreased to 67.9 % (36/53). This was in accordance with the study conducted in India, where he found live pregnancy rate of 99.2 % when ths YSD was 2-5 mm & it was 66.6 % when YSD was < 2 mm & > 5 mm[30]. Thus he concluded YSD of 2-5 mm as a normal range; where we have taken YSD of 3-5 mm as a normal range in our study.

Also in one more study conducted in India, the rate of the pregnancies which had abortions was 86.36 % (19/22) & the rate of pregnancies which continued was 13.64 % (3/22); when YSD was > 6 mm. Also all the pregnancies (78 cases) where YSD was < 6 mm, were continued. None of them had abortions[30]. But he studied the cases between 9-10 weeks of gestation; while we have studied between 6-10week6days of gestation in our study. Thus he found YSD > 6mm as a predictor of poor pregnancy outcome.

In another study in India, 88.89 % of the cases had abortions due to abnormal YSD. None of them had normal outcome. While when YSD was normal, 98.38 % of the cases (61/62) had normal outcome & only 1 case out of 62 had abortion[33].

In our study, 8.45 % cases (17/201) had abnormal outcome when YSD was normal & 32.07 % had abnormal outcome when YSD was abnormal as depicted in table 13. This was comparable with the other study where abortions due to abnormal YSD occurred in 35.71 % of the cases[44].

In another study, abortions due to abnormal YSD occurred in 64.5 % of the cases[22]. Here the percentage was more than our study. The reasons behind the differences in findings may be the smaller sample size of his study.

In our study we have also estimated the ideal time to perform the transvaginal scan, in order to achieve the highest possible sensitivity, specificity, positive and negative predictive value. Sensitivity, PPV and NPV was highest at 8th week of gestation & specificity was highest at 9th week of gestation. The Sensitivity & PPV were very poor at 7^{th} week of gestation. The overall sensitivity, specificity, positive and negative predictive value of predicting pregnancy outcome in our study was 50 %, 83.64 %, 32.08 % & 91.54 % respectively.(As shown in table 14)

The sensitivity, specificity and PPV of predicting an abnormal outcome was 26.9%, 92.7% and 51.1% respectively, reported by one study[36]. The results of our study are comparable to the results of this study. Also in other study[22], they found a yolk sac diameter out of 2 standard deviations of the mean for the menstrual age allowed prediction of an abnormal pregnancy outcome with a sensitivity of 65%, a specificity of 97%, PPV of 71% and a NPV of 95%.

Statistical analysis of yolk sac diameter as a predictor of pregnancy outcome was significant when measured between 8th and 9th week of Gestation as depicted in table 12. ($P < 0.05$). When the measurement were taken between 6^{th} to 7^{th} week of

gestation & at 10^{th} week of gestation, the results were not significant with a P value of 0.2420, 1.000 & 0.1574 respectively. This is in contrast to the studies done previously in which yolk sac could be accurately evaluated from 5 completed weeks of GA[3,36,32]. This might have resulted due to the small yolk sac size at this time of gestation combined with various other confounding factors like inaccuracy of menstrual dating, expertise of the sonographer, resolution of the transducers.

In the our study, Student t test was applied to test the significance of difference between the means of YSD of normal and abnormal pregnancy outcome. The difference between the mean yolk sac diameters between normal and abnormal outcomes was significant at a P value of 0.0261 (As per table 15).

Thus it shows highly significant correlation between YSD & pregnancy outcome.

CONCLUSION

We can conclude from our study that measurement of the secondary yolk sac diameter between 6th to 10 week 6 days of gestation can be used as a valuable tool in predicting outcome of the pregnancy. The YSD had sensitivity of 50 %, specificity of 83.64 %, positive predictive value of 32.08% and negative predictive value of 91.54% in predicting abnormal pregnancy outcome. In our study we got 34 cases with abnormal outcome out of total 254 cases; where 17 cases had abnormal YSD. Here P value was 0.0001 i.e statistically highly significant. Statistical analysis of yolk sac diameter as a predictor of pregnancy outcome was significant when measured between 8th and 9th week of Gestation. ($P < 0.05$).

The sensitivity, positive predictive value and negative predictive value were highest when the scan was performed at 8th week of gestation. The difference between the mean yolk sac diameters between normal and abnormal outcomes was significant ($P=0.0261$) in our study. So it was concluded that abnormal yolk sac can be used in predicting abnormal pregnancy outcome.

SUMMARY

This study was conducted to evaluate the role of yolk sac diameter in predicting pregnancy outcome.

In this study 254 women who presented to the antenatal OPD of KLE`s Dr. Prabhakar Kore Charitable Hospital & MRC,Belgavi, between 6 and 10 week 6 days of gestation were evaluated with transvaginal sonography and YSD was measured. All this data was collected from records & these patients were followed up to 24 weeks of gestational age and classified as normal outcomes if pregnancy continues beyond 24 weeks and if no anomalies of the foetus was noted.

The mean age of the study population was 23.94 ± 3 years and 72.44 % of the study population belonged to the age group of 21- 30 years. 61.42% of the study population were primigravidae. The probability of YSD did not vary with maternal age. (P =0.4572). The probability of YSD did not vary with the increase in gravidity also. (P = 0.3441) History of previous abortion had no correlation with YSD in our study. (P= 0.2456)

The P value was significant for the YSD at particular gestational age in both normal & abnormal outcome. When the comparison was made between normal & abnormal outcomes with mean YSD at each gestational age, P value was significant at 9 & 10 weeks of gestation. The P value was significant for 8 & 9 weeks of gestation when outcomes were compared with YSD in overall.

We had 13.38 % incidence of abnormal pregnancy outcome. A normal range of yolk sac diameter was considered as YSD of 3-5 mm & YSD < 3mm or > 5mm

was considered as abnormal. The P value was highly significant i.e 0.0001 for the outcomes in patients with normal & abnormal YSD in overall.

Using these criteria of yolk sac diameter to predict pregnancy outcome, sensitivity was 50 %, specificity was 83.64 %, positive predictive value was 32.08% and negative predictive value was 91.54%. The sensitivity, positive predictive value and negative predictive value were highest when thescan was performed at 8th week of gestation and specificity was highest at 9th week of gestation. At 7th week, the results obtained had poor sensitivity & PPV.

Student t test was applied and difference between the mean yolk sac diameters between normal and abnormal outcomes was significant (P=0.0261). Statistical analysis of yolk sac diameter as a predictor of pregnancy outcome was significant when measured between 8th and 9th week of gestation in our study. ($P < 0.05$).

Thus yolk sac diameter can be used as a valuable tool in predicting abnormal pregnancy outcome.

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ANNEXURE-I

PROFORMA

OP. NO. :

NAME :

AGE : years

ADDRESS :

PHONE NO. :

REG. NO. :

DATE OF EXAMINATION :

OBSTETRIC SCORE :

LMP : EDD:

GESTATIONAL AGE : days

ANY COMPLAINTS :

MENSTRUAL HISTORY : Regular / Irregular

Duration: days

MARITAL HISTORY : Married life: years

OBSTETRIC HISTORY:

ULTRASOUND :

Ultrasound Parameters	TVS Scan at 6-10 weeks	Scan at 11-14 weeks	Anomaly scan at 20 weeks
Yolk sac diameter (mm)			

FOLLOW UP VISITS :

FOLLOW UP ULTRASOUND :

DATE

FINDINGS :

OUTCOME :

1. Abnormal
    - Anembryonic pregnancy
    - Missed abortion
    - Incomplete abortion/ Complete Abortion /Threatened abortion
    - Anomalous foetus
    - Preterm labour

2. Normal (pregnancy continued beyond 24 wks with no anomalies)

Signature:

Date:

MASTER CHART

SR NO	OP NO	NAME	SCAN ID	DOE	AGE	GA	GRAVIDA	PREVIOUS ABORTIONS	YSD	OUTCOME
1	3167839	MALATI RAO	27475	7-Jan-15	22	10WK6D	PRIMI	NIL	5.2	NORMAL
2	3198879	ANITA PATIL	27477	7-Jan-15	24	10 WK 6 D	PRIMI	NIL	5.6	NORMAL
3	3152922	VIDYASHREE PATTANSHETTI	27456	5-Jan-15	29	6 WK	G2A1	1	2.9	ABNORMAL
4	1222274	PALLAVI PRABHAVALKAR	27390	1-Jan-15	20	9 WK 5 D	PRIMI	NIL	4	NORMAL
5	1967050	SUVARNA PATIL	27394	1-Jan-15	19	10 WK	PRIMI	NIL	4.6	NORMAL
6	3203664	LAXMI PATIL	27802	2-Feb-15	22	10 WK 2 D	G3A2	2	5.3	ABNORMAL
7	3290334	RAJASHREE SUTAR	27808	2-Feb-15	24	9 WK 3 D	G2P1L1	NIL	4.8	NORMAL
8	3315081	RENUKA HADPAD	278925	3-Feb-15	32	10 WK	PRIMI	NIL	4	NORMAL
9	3019096	AYESHA SHAIKH	27578	14-Jan-15	25	10 WK 5 D	PRIMI	NIL	5.2	NORMAL
10	3255940	LAXMI KOLI	27831	4-Feb-15	19	10 WK 1 D	G2A1	1	4.7	NORMAL
11	3255933	SHRIDEVI GOUDAR	27832	4-Feb-15	20	10 WK	PRIMI	NIL	5	ABNORMAL
12	3256420	RESHMA MAGDUM	27836	4-Feb-15	22	10 WK 5 D	G3P2L2	NIL	4	NORMAL
13	3256414	KAVERI METGUDMATH	27837	4-Feb-15	27	9 WK 3 D	PRIMI	NIL	3.4	NORMAL
14	3264522	RAJESHWARI HIREMATH	27838	4-Feb-15	21	9 WK 5 D	G2P1L1	NIL	3	NORMAL
15	3192215	LAXMI NIDGALKAR	27859	5-Feb-15	20	8 WK 5 D	G3P1L1A1	1	3.5	NORMAL
16	3318747	VARSHA MATIVADDAR	27868	6-Feb-15	23	10 WK 3 D	G2P1L1	NIL	4	NORMAL
17	3279840	RADHA SUTAR	27481	7-Jan-15	20	10 WK	PRIMI	NIL	5	NORMAL
18	3325720	ANURADHA KAMBLE	27885	7-Feb-15	19	10 WK 3 D	G3P1L1A1	NIL	5	ABNORMAL
19	3315148	DANASHRI BELGEONKAR	27919	10-Feb-15	20	7 WK	PRIMI	NIL	3.5	NORMAL
20	3306380	ASWINI MANNOLKAR	27916	10-Feb-15	19	9 WK 1 D	PRIMI	NIL	4	NORMAL
21	3287289	GEETA KOLEKAR	27931	10-Feb-15	29	10 WK 2 D	G2A1	1	5	ABNORMAL
22	2146728	SHILPA PUJAR	27929	10-Feb-15	29	6 WK 2 D	G3P2L2	NIL	3	NORMAL

23	3296280	ANJALI JAIN	27941	11-Feb-15	22	9 WK 4 D	PRIMI	NIL	4	NORMAL
24	3321342	JIYASANI BAGAVAN	22438	22-Feb-15	21	9 WK 5 D	PRIMI	NIL	4.5	NORMAL
25	3249772	MUKTA PATIL	27786	31-Jan-15	18	8 WK 1 D	PRIMI	NIL	4	NORMAL
26	3321204	SHOBHA KALLAPA	25405	22-Feb-15	24	9 WK 3 D	G2A1	1	4	NORMAL
27	3327019	LAXMI HIEREMATH	27971	12-Feb-15	18	10 WK 3 D	PRIMI	NIL	5.4	NORMAL
28	3326351	SUNANDA PATIL	27964	12-Feb-15	19	10 WK 6 D	PRIMI	NIL	6	ABNORMAL
29	3323669	SHEETAL CHOUGALE	27974	13-Feb-15	26	8 WK 3 D	G3P2L1	NIL	3.8	NORMAL
30	796690	MALA DHADED	27978	13-Feb-15	27	6 WK 5 D	G2P1L1	NIL	3	NORMAL
31	3327753	RANI DEEPAK	27981	13-Feb-15	22	7 WK 3 D	PRIMI	NIL	3.7	NORMAL
32	3326384	RANJANA JAGDISH	27992	14-Feb-15	29	6 WK 2 D	G3P1L1A1	1	2.9	ABNORMAL
33	3219238	RAVINA VILAS	28000	16-Feb-15	19	8 WK 6 D	PRIMI	NIL	4.4	NORMAL
34	3236871	ANIS FATIMA	28022	18-Feb-15	24	08 WK	PRIMI	NIL	3.9	ABNORMAL
35	3279483	URMILA SUNIL	28026	18-Feb-15	24	7 WK	G2P1L1	NIL	3	NORMAL
36	3301669	LAXMI NILAPPA	28033	19-Feb-15	27	8 WK 1 D	G2P1L1	NIL	4	NORMAL
37	3335675	SUVARNA PRAVEEN	28060	20-Feb-15	24	10 WK 4 D	PRIMI	NIL	6	ABNORMAL
38	3106129	SUNITA GURUNATH	27412	2-Jan-15	17	10 WK 1 D	PRIMI	NIL	6.1	NORMAL
39	3322288	SUMANGALA PATIL	28078	23-Feb-15	22	09 WK 2 D	G2A1	1	3.8	NORMAL
40	3331188	BHARATA PRADEEP	28082	23-Feb-15	21	10 WK 2 D	PRIMI	NIL	5.8	NORMAL
41	3334298	RUKSAR BAGAVAN	28083	23-Feb-15	22	09 WK 4D	PRIMI	NIL	4	NORMAL
42	3326181	PRIYANKA VINAYAK	28132	26-Feb-15	22	10 WK 3 D	G2P1L0	NIL	5.4	NORMAL
43	3342619	GAYATRI JADAV	28148	26-Feb-15	26	07 WK 5 D	G3A2	2	3.4	NORMAL
44	3344623	KASTURI ROHAN	28164	27-Feb-15	25	07 WK 2 D	G2A1	1	3	ABNORMAL
45	3198534	RUKMINI UPPANAVAR	28117	25-Feb-15	22	08 WK 3 D	PRIMI	NIL	4	NORMAL
46	3338681	NILOFER AMANAGI	28177	2-Mar-15	20	10WK2D	PRIMI	NIL	5	NORMAL
47	3283286	REKHA INGOLE	28205	3-Mar-15	35	9WK2D	G4P2L2A1	1	4.6	NORMAL
48	3341982	SHWETA HUBBALLI	28216	4-Mar-15	24	9WK6D	G2A1	1	4.5	ABNORMAL
49	3341882	LAXMI CHOUGULE	28218	4-Mar-15	25	9WK	G3P1L1A1	1	4	NORMAL

50	3313852	RENUKA SHINDE	28225	4-Mar-15	23	9WK	PRIMI	NIL	4	NORMAL
51	3251708	SANDHYA MANDOLKAR	27529	10-Jan-15	27	10WK3D	G2P1L1	NIL	6.1	NORMAL
52	3019496	AKSHATA VAIDYA	28236	5-Mar-15	26	8WK4D	PRIMI	NIL	3.8	NORMAL
53	3330904	UJWALA KATAMBLE	28246	9-Mar-15	22	9WK5D	PRIMI	NIL	4	NORMAL
54	3346788	ASHWINI VINAY	28261	9-Mar-15	28	8WK2D	G2P1L1	NIL	4	NORMAL
55	3277001	RASMITA PARASHARAM	27754	29-Jan-15	21	9WK	PRIMI	NIL	5	NORMAL
56	3340718	BHAGYASHREE RAVI	28315	13-Mar-15	21	6WK1D	PRIMI	NIL	3	NORMAL
57	3312804	JYOTI MANOJ	28318	17-Mar-15	21	6WK4D	PRIMI	NIL	2.7	ABNORMAL
58	3280286	ARKINA SHAIKH	28324	14-Mar-15	20	8WK	PRIMI	NIL	4	NORMAL
59	3313850	SABA AFREEN	28344	16-Mar-15	24	10WK6D	G2P1L0	NIL	5	NORMAL
60	3019498	SAVITA BASAVANT	28357	16-Mar-15	29	9WK6D	G2P1L1	NIL	4.7	NORMAL
61	3364627	SHAILA REVAPPA	28365	16-Mar-15	25	9WK3D	G2A1	1	5	ABNORMAL
62	3150924	SUREKHA YALLAPPA	27562	13-Jan-15	21	8WK5D	G2P1L1	NIL	4	NORMAL
63	3357480	SAVITA PUJAR	28402	19-Mar-15	22	7WK	PRIMI	NIL	3.6	NORMAL
64	3368590	AKKAMAHADEVI PATIL	28410	19-Mar-15	32	8WK4D	G5P2L2A2	2	4.5	NORMAL
65	3369748	BHARATI NINGAPPA	28411	19-Mar-15	22	9WK	PRIMI	NIL	4	NORMAL
66	3070692	TEJASWINI PATIL	28424	20-Mar-15	23	9WK6D	PRIMI	NIL	5	NORMAL
67	3370845	SUJATA RAVI	28427	23-Mar-15	22	7WK3D	G2A1	1	3.6	NORMAL
68	3372345	RESHMA BANU	28437	23-Mar-15	25	8WK6D	PRIMI	NIL	4	ABNORMAL
69	3372348	MAHADEVI BAVARAJ	28442	23-Mar-15	24	6WK5D	G2A1	1	3	NORMAL
70	3372450	REKHA ANIL	28447	24-Mar-15	22	6WK6D	PRIMI	NIL	3	NORMAL
71	3374352	SNEHAL MANJUNATH	28448	24-Mar-15	28	8WK6D	G2P1L1	NIL	4	NORMAL
72	3376698	VAISHALI AMBAJI	28473	26-Mar-15	20	10WK5D	PRIMI	NIL	6	NORMAL
73	3376731	ASIFA PATEL	28479	26-Mar-15	29	7WK5D	G2A1	1	3	NORMAL
74	3375468	MADHUMATI MORE	28490	27-Mar-15	23	9WK5D	PRIMI	NIL	5	NORMAL
75	3379870	IRAWWA MALLESH	28511	28-Mar-15	23	10WK6D	G2A1	1	6	NORMAL
76	3384528	MANJULA SURESH	28516	30-Mar-15	25	10WK5D	G2P1L1	NIL	5	NORMAL

77	3384248	AMRUTA SURESH	28525	30-Mar-15	19	10WK6D	PRIMI	NIL	6	NORMAL
78	3381045	ROOPA KIRAN	28530	31-Mar-15	24	9WK2D	G3A2	2	4	ABNORMAL
79	3394216	POONAM PRAKASH	28557	1-Apr-15	22	9WK	PRIMI	NIL	4	NORMAL
80	3130825	DIVYA BHARATI	28559	1-Apr-15	22	9WK1D	PRIMI	NIL	4	NORMAL
81	3294261	AKSHTA PATIL	27531	10-Jan-15	19	10WK3D	PRIMI	NIL	5	NORMAL
82	3130526	POOJA GORAL	28563	2-Apr-15	24	8WK1D	G2A1	1	4	NORMAL
83	3131787	DEMAVVA CHAMBAPPA	28587	4-Apr-15	23	6WK1D	G2A1	1	3	ABNORMAL
84	3133467	SHRUTI RAKESH	28595	7-Apr-15	21	9WK	PRIMI	NIL	5	NORMAL
85	3384286	MADHUSHREE RAVI	28615	8-Apr-15	18	10WK	PRIMI	NIL	5	NORMAL
86	3394183	RUPALI BHAVAKANNA	28631	9-Apr-15	25	7WK6D	PRIMI	NIL	3	NORMAL
87	3395202	BHARATI CHINAPPA	28634	10-Apr-15	22	9WK	PRIMI	NIL	4	NORMAL
88	3395402	KADAMBARI KESHAV	28653	11-Apr-15	22	10WK2D	PRIMI	NIL	6	NORMAL
89	3396802	NEELAMMA SULADAL	28665	13-Apr-15	25	8WK6D	G2P1L1	NIL	4	NORMAL
90	3397811	LAXMI PRAKASH	28670	13-Apr-15	24	9WK3D	G2P1L1	NIL	4.8	NORMAL
91	3398402	NAGAVENI PRAKASH	28683	14-Apr-15	21	10WK5D	PRIMI	NIL	6	NORMAL
92	3398450	VIDYA KESTI	28721	17-Apr-15	21	10WK	PRIMI	NIL	5	NORMAL
93	3399520	SUKANYA PATIL	28746	20-Apr-15	23	6WK1D	G2A1	1	2	NORMAL
94	3400205	MAYA JADHAV	28748	20-Apr-15	22	9WK	PRIMI	NIL	5	ABNORMAL
95	3644528	MANALI PATIL	26895	3-Dec-15	22	10WK2D	PRIMI	NIL	2.7	NORMAL
96	3401001	GANGAVVA HONAPPA	28786	23-Apr-15	35	8WK1D	G5P1L1A3	3	4	NORMAL
97	3401012	LALITA SATERI	28830	27-Apr-15	21	9WK3D	PRIMI	NIL	4.9	NORMAL
98	3401120	JYOTI SACHIN	28836	28-Apr-15	22	7WK6D	PRIMI	NIL	4	NORMAL
99	3416842	SHARANAMMA	28841	28-Apr-15	29	10WK	G3P1L1A1	1	5.4	ABNORMAL
100	3417983	SHREEDEVI AMIT	28867	30-Apr-15	25	9WK1D	PRIMI	NIL	5	NORMAL
101	3420465	GEETA VIJAY	28898	5-May-15	35	9WK3D	G4P1L1A2	2	4.4	NORMAL
102	3019084	POOJA SHINDE	27563	13-Jan-15	21	10WK	PRIMI	NIL	5	NORMAL
103	3426623	MANJULA GANTI	28937	8-May-15	27	6WK6D	G2P1L1	NIL	3.2	NORMAL

104	3324080	LAXMI RAHUL	27859	5-Feb-15	20	8WK5D	PRIMI	NIL	3.5	NORMAL
105	3427988	MAHADEVI KAMBHAR	28952	9-May-15	31	8WK5D	G3P1L1A1	1	6	ABNORMAL
106	1386422	RANI BHIMASI	28962	9-May-15	21	10WK	PRIMI	NIL	5.6	NORMAL
107	3429401	NIRMALA MANJUNATH	28967	11-May-15	22	9WK5D	PRIMI	NIL	5	NORMAL
108	3430589	VANI HARIGOUDA	28979	12-May-15	21	9WK6D	PRIMI	NIL	4	NORMAL
109	3430631	NAVYASHREE RAVISHANKAR	28997	12-May-15	25	9WK5D	G2P1L1	NIL	4	NORMAL
110	3438625	RUKAYYA MULLA	28999	13-May-15	19	9WK5D	PRIMI	NIL	4.1	NORMAL
111	3435628	MUMTAZ ANSARI	29017	14-May-15	37	9WK2D	G5P2L2A2	2	2	NORMAL
112	3436130	SHRIDEVI BIRADAR	29014	16-May-15	30	9WK5D	G3P1L1A1	1	6	ABNORMAL
113	3478210	MAHADEVI LAVA	29049	18-May-15	25	9WK6D	PRIMI	NIL	5	NORMAL
114	3484245	BHUVANESHWARI KALAL	29065	18-May-15	27	8WK	G2P1L1	NIL	3.7	NORMAL
115	3449148	RAJESHWAREE FAKIRAPPA	29075	19-May-15	24	10WK2D	PRIMI	NIL	5	NORMAL
116	3449245	VIJAYALAXMI HIREMATH	29084	19-May-15	22	7WK5D	PRIMI	NIL	3.6	NORMAL
117	3446240	SHREEDEVI UNKALA	29102	21-May-15	20	8WK5D	PRIMI	NIL	4.2	NORMAL
118	3439510	KAVITA SIDAPPA	29125	23-May-15	20	9WK3D	PRIMI	NIL	6	ABNORMAL
119	3448346	DEEPA SACHIN	29152	26-May-15	23	9WK3D	PRIMI	NIL	4	NORMAL
120	3448640	FAKIRAMMA SHIVANAND	29158	26-May-15	20	9WK1D	PRIMI	NIL	4.8	NORMAL
121	3448313	ROOPA SHINTRE	29159	26-May-15	38	8WK2D	G6P3L2A2	2	3.9	NORMAL
122	1411465	ASHWINI GIRISH	29186	29-May-15	26	8WK	G2P1LO	NIL	4	NORMAL
123	3451304	GEETA ANGADI	29181	28-May-15	28	8WK1D	PRIMI	NIL	4	NORMAL
124	3438425	VARSHA DEEPAK	29198	13-May-15	29	7WK2D	G2P1L1	NIL	3.8	NORMAL
125	3453988	MALA SOMATH	29199	30-May-15	19	9WK6D	PRIMI	NIL	6	ABNORMAL
126	3454645	SHWETA PRASHANT	29201	30-May-15	23	6WK6D	G2A1	1	6	NORMAL
127	3456491	PRIYANKA SANTOSH	29211	2-Jun-15	21	9WK4D	PRIMI	NIL	4	NORMAL
128	3440285	CHRISTINA ANIL	29214	1-Jun-15	23	9WK1D	PRIMI	NIL	4	NORMAL
129	3447284	BHAGYASHREE SHANKAR	29221	2-Jun-15	25	9WK	G2A1	1	4	NORMAL
130	3459532	PREMA AMOL	29257	4-Jun-15	31	8WK5D	G3A2	2	4	NORMAL

131	3459844	PRIYA DESAI	29264	4-Jun-15	23	9WK	PRIMI	NIL	4.8	NORMAL
132	3460015	GEETA NAIKAR	29280	6-Jun-15	24	8WK1D	PRIMI	NIL	6	ABNORMAL
133	3460019	LAXMI GOUDA	29289	6-Jun-15	19	8WK3D	PRIMI	NIL	4	NORMAL
134	3460125	MAHADEVI CHANDRAPPA	29291	6-Jun-15	32	10WK3D	G3P1L1A1	1	5	NORMAL
135	3461245	JAYASHREE BASAVRAJ	29294	6-Jun-15	30	9WK5D	G3P2L2	NIL	5	NORMAL
136	3466584	SHIVLEELA NAGRATNAM	29335	10-Jun-15	30	8WK3D	G2P1L1	NIL	3.9	NORMAL
137	3470592	UMA ISHWAR	29374	13-Jun-15	24	6WK4D	PRIMI	NIL	3	NORMAL
138	3470528	NIRMALA ANADAPPA	29375	13-Jun-15	28	7WK1D	G2P1L1	NIL	3	NORMAL
139	3470482	PREMA KOLI	29376	13-Jun-15	30	8WK	G2A1	1	3.8	NORMAL
140	3470736	NEELA HIREMATH	29377	13-Jun-15	20	9WK3D	PRIMI	NIL	4	NORMAL
141	3778428	SNEHAL PATIL	29404	16-Jun-15	25	10WK	G2A1	1	5	NORMAL
142	3488853	HAMIZA ABDULAMI	29536	29-Jun-15	24	6WK3D	PRIMI	NIL	2	NORMAL
143	3487842	SAVITRI VAGGAR	29533	29-Jun-15	19	6WK3D	PRIMI	NIL	3	ABNORMAL
144	3489720	ZEBA SHAHID	29530	29-Jun-15	23	9WK4D	PRIMI	NIL	4	NORMAL
145	3489924	NANDINI AKKI	29547	30-Jun-15	27	8WK4D	G2A1	1	3	NORMAL
146	3491763	PRATIKSHA GURAV	29557	1-Jul-15	20	7WK5D	PRIMI	NIL	3.5	NORMAL
147	3492601	LAXMI KAMBLE	29563	2-Jul-15	25	8WK4D	PRIMI	NIL	4	NORMAL
148	3494373	VINUTA SACHIN	29595	3-Jul-15	19	8WK4D	PRIMI	NIL	4	NORMAL
149	3498382	GEETA PATIL	29604	4-Jul-15	22	9WK2D	PRIMI	NIL	3	NORMAL
150	3500024	FARZANA PATEL	29554	4-Jul-15	21	9WK2D	PRIMI	NIL	4	ABNORMAL
151	3500054	SHILPA DESAI	29610	4-Jul-15	25	10WK4D	G2A1	1	5	NORMAL
152	3500681	SHILPA NAVI	29658	8-Jul-15	21	9WK6D	PRIMI	NIL	4	NORMAL
153	3501552	VIDYA CHACHADI	29666	9-Jul-15	21	10WK5D	PRIMI	NIL	5	NORMAL
154	3501578	SHOBHA SURESH	29668	9-Jul-15	26	7WK2D	G2A1	1	3	NORMAL
155	3503482	PADMAJA PATIL	29701	11-Jul-15	23	10WK5D	G2A1	1	5	NORMAL
156	3505827	KANCHAN RAJU	29695	11-Jul-15	38	7WK5D	G3P1L1A1	1	3.1	NORMAL
157	3506623	IRAMMA ROTTI	29719	13-Jul-15	22	10WK4D	PRIMI	NIL	4.8	NORMAL

158	3506734	ROOPA SURESH	29968	22-Jul-15	21	7WK4D	PRIMI	NIL	3.5	NORMAL
159	3576245	PRIYANKA PANKAJ	29816	23-Jul-15	31	8WK	G2P1L1	NIL	3.6	NORMAL
160	3486073	BHAKTI MAHAVEER	29821	24-Jul-15	20	10WK	PRIMI	NIL	5	NORMAL
161	3518470	VIJAYA JAMADARKANI	29834	25-Jul-15	19	10WK2D	PRIMI	NIL	4.6	NORMAL
162	3521547	MAYA PATIL	29841	25-Jul-15	26	10WK3D	G2P1L1	NIL	4.3	NORMAL
163	3524799	ANI RANJIT	29866	28-Jul-15	27	7WK2D	G2P1L1	NIL	5	ABNORMAL
164	3527075	VIDYASHREE PATIL	29882	30-Jul-15	25	9WK4D	PRIMI	NIL	3.2	NORMAL
165	3301669	ASHWINI SANJAY	29887	30-Jul-15	22	6WK6D	PRIMI	NIL	3	NORMAL
166	3473451	HEENA THAKUR	29897	31-Jul-15	25	10WK	PRIMI	NIL	4	NORMAL
167	3516065	VIDYASHREE TELI	29899	31-Jul-15	22	10WK6D	PRIMI	NIL	3	NORMAL
168	3520362	RESHMA JADHAV	29904	31-Jul-15	23	8WK1D	PRIMI	NIL	3	NORMAL
169	3340493	REKHA KALMESH	29906	31-Jul-15	24	6WK3D	G2A1	1	3.5	NORMAL
170	3506717	BIBIKHUTEJA	29919	1-Aug-15	32	10WK	G4P1L1A2	2	4.8	NORMAL
171	3514216	BALAVVA BORGALI	29929	3-Aug-15	22	10WK3D	PRIMI	NIL	5	NORMAL
172	3514449	SUMITRA NAGRAJ	29937	3-Aug-15	19	10WK	PRIMI	NIL	5	NORMAL
173	3506429	LAXMI GURAV	29938	3-Aug-15	24	9WK3D	PRIMI	NIL	3.9	NORMAL
174	3524210	LAXMI RAJANNA	29947	4-Aug-15	24	9WK3D	PRIMI	NIL	4	ABNORMAL
175	3226538	GEETA RAMU	29950	4-Aug-15	32	6WK4D	G4A3	3	3	NORMAL
176	3237542	KAVERI JANAGOUDA	29976	6-Aug-15	20	10WK2D	PRIMI	NIL	5	NORMAL
177	3328450	SHILPA MANJUNATH	29998	7-Aug-15	25	6WK4D	PRIMI	NIL	3	NORMAL
178	3497495	SHRIDEVI ABHIJIT	30026	10-Aug-15	24	9WK1D	PRIMI	NIL	4	NORMAL
179	3525623	AMOLIKA SANTOSH	30059	12-Aug-15	29	9WK1D	G2P1L1	NIL	5	NORMAL
180	2451654	MAHESHWARI	30070	13-Aug-15	26	6WK1D	PRIMI	NIL	3	NORMAL
181	2673386	ANANTAMATI	30124	20-Aug-15	22	7WK2D	PRIMI	NIL	3.8	NORMAL
182	3501773	RADHIKA KIRAN	30152	22-Aug-15	24	6WK4D	G2A1	1	2.8	NORMAL
183	3581429	LAXMI HADAPAD	30161	24-Aug-15	23	9WK6D	PRIMI	NIL	4.8	NORMAL
184	3544833	TASFIYA SHAIKH	30188	27-Aug-15	21	10WK6D	PRIMI	NIL	5.6	NORMAL

185	3565630	KANCHAN PATIL	30287	4-Sep-15	26	6WK6D	PRIMI	NIL	3	NORMAL
186	3571448	SUVARNA PATIL	30323	7-Sep-15	24	7WK2D	PRIMI	NIL	3.2	ABNORMAL
187	3551154	RESHMA SUNIL	30345	9-Sep-15	29	10WK4D	G2P1L1	NIL	5.2	NORMAL
188	2206223	BASAMMA BASAVANT	30349	9-Sep-15	24	10WK6D	PRIMI	NIL	5	NORMAL
189	3552398	SWATI GURURAJ	30353	10-Sep-15	23	10WK	PRIMI	NIL	5	NORMAL
190	3510670	RESHMA SHIVAJI	30373	12-Sep-15	23	9WK6D	G2A1	1	4	NORMAL
191	3546486	POOJA SAGAR	30466	22-Sep-15	20	10WK6D	PRIMI	NIL	6	ABNORMAL
192	3464344	SNEHA YADAV	30511	25-Sep-15	24	7WK2D	PRIMI	NIL	3	NORMAL
193	3565197	JAYASHREE SHETTI	30534	26-Sep-15	25	7WK3D	PRIMI	NIL	4	NORMAL
194	3595020	MANDIRA CHETAN	30594	1-Oct-15	22	9WK5D	G2A1	1	4	NORMAL
195	3585397	LAXMI NAIK	30599	3-Oct-15	22	9WK4D	PRIMI	NIL	6	NORMAL
196	3490141	KAVERI TORASE	30641	6-Oct-15	20	8WK2D	PRIMI	NIL	4	NORMAL
197	3593259	SWALEHYA MULLA	30576	7-Oct-15	22	7WK3D	PRIMI	NIL	3.8	NORMAL
198	3598040	SUVARNA ARUN	30658	8-Oct-15	21	9WK5D	PRIMI	NIL	4	NORMAL
199	3593390	VIJAYALAXMI MANJUNATH	30668	24-Oct-15	20	10WK4D	PRIMI	NIL	7	NORMAL
200	3615017	JYOTSNA AMIT	30694	15-Oct-15	31	7WK6D	G3P1L1A1	1	3.8	NORMAL
201	3439362	ZEENAT HOSKOTI	30720	13-Oct-15	23	6WK5D	PRIMI	NIL	3	NORMAL
202	3525906	POONAM PATIL	30733	14-Oct-15	33	7WK4D	G3P1L1A1	1	3.8	NORMAL
203	3616381	RAJLAXMI GAVADE	30791	19-Oct-15	22	10WK	PRIMI	NIL	5	NORMAL
204	3626463	MANISHA JAGANNATH	30812	20-Oct-15	22	9WK5D	PRIMI	NIL	5	NORMAL
205	3835458	RENUKA HANAMANTH	30786	26-Oct-15	28	8WK3D	G2A1	1	2	ABNORMAL
206	3631980	SAROJA MANJUNATH	30859	26-Oct-15	24	9WK4D	PRIMI	NIL	4.5	NORMAL
207	2975219	BENAZIR JAMADAR	30879	27-Oct-15	23	8WK6D	PRIMI	NIL	5	NORMAL
208	3631171	MANISHA JAYAVANT3	30922	29-Oct-15	21	9WK3D	PRIMI	NIL	3	NORMAL
209	3600928	POOJA NAIK	30937	30-Oct-15	21	8WK2D	G2A1	1	6	ABNORMAL
210	3611465	JAYSHEELA SHIVANAND	30955	31-Oct-15	23	10WK	G2A1	1	6	NORMAL
211	3632367	DHANASHREE EKNATH	30959	31-Oct-15	29	9WK2D	G2P1L1	NIL	4	NORMAL

212	3639561	PUSHPA PATIL	30972	31-Oct-15	27	9WK5D	G3P1L1A1	1	6	NORMAL
213	3624428	ROOPA BABU	30999	3-Nov-15	24	10WK6D	PRIMI	NIL	4	NORMAL
214	3634890	SARIKA PATIL	31018	4-Nov-15	24	10WK2D	PRIMI	NIL	5	NORMAL
215	3635068	INDU KAMBLE	31024	4-Nov-15	21	7WK2D	PRIMI	NIL	6	NORMAL
216	3644271	MAHESHWARI SANTOSH	31026	4-Nov-15	20	8WK4D	PRIMI	NIL	7	NORMAL
217	3644305	KASTURI SANJAY	31027	4-Nov-15	21	6WK2D	PRIMI	NIL	3	NORMAL
218	3644292	REKHA BANDAGI	31602	4-Nov-15	27	10WK6D	G2P1L1	NIL	5.1	NORMAL
219	2760542	PRIYANKA GOURAJ	31032	5-Nov-15	19	9WK6D	PRIMI	NIL	6	ABNORMAL
220	3651668	REKHA PATIL	31111	10-Nov-15	22	10WK3D	PRIMI	NIL	4.9	NORMAL
221	3659378	SNEHAL SHINDE	31180	17-Nov-15	26	10WK6D	PRIMI	NIL	5.3	NORMAL
222	3644184	GEETA BADIGER	31212	18-Nov-15	20	10WK6D	PRIMI	NIL	4.4	NORMAL
223	3662311	MALAN TUKARAM	31218	19-Nov-15	24	8WK6D	G2A1	1	4	NORMAL
224	3497857	GADIGEVVA SIDAPPA	31270	23-Nov-15	19	8WK4D	PRIMI	NIL	4	NORMAL
225	3644637	SANA ASHFAK	31413	2-Dec-15	20	10WK6D	PRIMI	NIL	5	NORMAL
226	3678214	SUSHILA PATIL	31485	8-Dec-15	20	10WK5D	PRIMI	NIL	3	NORMAL
227	3687731	VIJAYALAXMI ASHOK	31493	8-Dec-15	25	10WK6D	PRIMI	NIL	4	NORMAL
228	3689898	LAXMI ADIVEPPA	31508	23-Dec-15	35	8WK3D	G4P2L2A1	1	6	NORMAL
229	3709331	SHOBHA PATIL	31735	23-Dec-15	33	6WK6D	G3P1L1A1	1	3	NORMAL
230	3694512	NIRMALA VIKAS	31740	24-Dec-15	20	8WK2D	PRIMI	NIL	4	NORMAL
231	3710110	KAVERI ADINATH	31743	24-Dec-15	24	7WK6D	PRIMI	NIL	4	NORMAL
232	3701539	MANJULA SANTOSH	31748	24-Dec-15	28	7WK	G2P1L1	NIL	3.5	NORMAL
233	3694201	SUVARNA PRAKASH	31756	26-Dec-15	26	7WK	PRIMI	NIL	5	NORMAL
234	3715421	SHANTAWA YALAPPA	31803	29-Dec-15	32	8WK3D	G3A2	2	4	NORMAL
235	3714881	SUVARNA RAMDAS	31857	1-Jan-16	23	10WK4D	PRIMI	NIL	7.3	ABNORMAL
236	3686278	TANUJA SANTOSH	31854	1-Jan-16	23	10WK3D	PRIMI	NIL	5	NORMAL
237	3719617	MALASHREE NAGAPPA	31859	1-Jan-16	22	10WK6D	PRIMI	NIL	6	NORMAL
238	3699785	NETRAVATI MAHANTESH	31870	2-Jan-16	24	9WK4D	PRIMI	NIL	4	ABNORMAL

239	1377492	SHILPA MAHESH	31888	4-Jan-16	29	7WK5D	G2P1L1	NIL	3	NORMAL
240	3235337	BHAGYASHREE ANAD	31931	7-Jan-16	22	7WK4D	PRIMI	NIL	3.1	NORMAL
241	2776561	ANURADHA BADIGER	31951	8-Jan-16	18	10WK4D	PRIMI	NIL	5.1	NORMAL
242	3730235	POONAM MAHESH	31964	8-Jan-16	31	6WK2D	G2P1L1	NIL	5	NORMAL
243	3719967	GEETA NAGENDRA	31966	9-Jan-16	21	9WK	PRIMI	NIL	4	NORMAL
244	3714563	VIDYA VINAYAK	31980	11-Jan-16	26	7WK6D	PRIMI	NIL	6	NORMAL
245	3642506	SUPRIYA AKASH	31986	11-Jan-16	20	10WK6D	PRIMI	NIL	5	NORMAL
246	3731505	AKSHATA SHETTI	32017	12-Jan-16	33	8WK2D	G3P1L1A1	1	3	NORMAL
247	3731555	SAVITA DUNDAYYA	32050	14-Jan-16	25	9WK6D	PRIMI	NIL	4	NORMAL
248	3737863	SHOBHA NAIK	32051	14-Jan-16	28	8WK5D	G2P1L1	NIL	3	NORMAL
249	3737863	RENUKA SHIVAJI	32055	14-Jan-16	26	6WK6D	PRIMI	NIL	3	NORMAL
250	3742132	YASHODA TURAI	32087	18-Jan-16	19	10WK3D	PRIMI	NIL	4.8	NORMAL
251	3743845	LAXMI RAJU	32557	19-Feb-16	25	10WK5D	G2A1	1	5	NORMAL
252	3734647	LAXMI SHANKARAPPA	32573	19-Feb-16	19	10WK6D	PRIMI	NIL	6	NORMAL
253	3752304	MADHURI KAMBLE	32589	20-Feb-16	24	6WK2D	PRIMI	NIL	6	NORMAL
254	3745281	LAXMIVEENA	32681	27-Feb-16	23	9WK6D	PRIMI	NIL	4	NORMAL

ANNEXURE III – KEY TO MASTER CHART

SR. NO.	-	Serial Number
OP. NO.	-	Out Patient Number
ID	-	Identification
DOE	-	Date Of Examination
GA	-	Gestational Age
YSD	-	Yolk Sac Diameter