A Dissertation on

YOLK SAC MEASUREMENTS AND EMBRYONIC HEART RATE IN PREDICTING FIRST TRIMESTER PREGNANCY OUTCOME

Dissertation submitted to

THE TAMIL NADU Dr.M.G.R.MEDICAL UNIVERISTY

CHENNAI.

with partial fulfilment of the regulations

for the Award of the degree of

M.D., (Obstetrics & Gynaecology)

Branch – II

STANLEY MEDICAL COLLEGE
CHENNAI.

APRIL 2012

BONAFIDE CERTIFICATE

Certified that this dissertation is the bonafide work of Dr. K.JEEVITHA on ***YOLK SAC MEASUREMENTS AND EMBRYONIC HEART RATE IN PREDICTING FIRST TRIMESTER PREGNANCY OUTCOME*** during his M.D.,(Obstetrics & Gynaecology) course from April 2009 to April 2012 at the Stanley Medical College and Raja Sir Ramasamy Mudaliar Lying-in Hospital, Chennai.

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ACKNOWLEDGEMENT

At the outset, I would like to place on record my deep sense of gratitude to the Dean, Stanley Medical College and *Prof.Dr.N.Hephzibah kirubamani, M.D., D.GO., MICOG., PhD,* Professor and Head of the Department of Obstetrics & Gynaecology, RSRM lying in hospital, for allowing me to undertake this study on **YOLK SAC MEASUREMENTS AND EMBRYONIC HEART RATE IN PREDICTING FIRST TRIMESTER PREGNANCY OUTCOME** with much avidity.

In keeping with the maxim, “All is well that ends well”, I was able to carry out my study to my fullest satisfaction, thanks to guidance, encouragement, motivation and constant supervision extended to me, by my beloved Chief *Prof. Dr.Bagyalakshmi,* M.D., D.GO., Professor and Chief of Unit III. Hence my profuse thanks are due for her.

I would be failing in my duty if I don’t place on record my sincere thanks to those patients who were the subjects of my study.

I am bound by ties of gratitude to my respected Assistant Professor Dr.Lavanya and all others in general, for placing, guiding and goading me on the right track from the very beginning of my career in Obstetrics and Gynaecology and till this day.

I am fortunate to have my colleague PG’s of RSRM Lying hospital for their invaluable suggestions, relentless help for shouldering my responsibilities. Simply words cannot express its depth for their unseen contributions.

Lastly, my lovable thanks to my husband and my family for their moral support.

CONTENTS

Introduction

1.0 INTRODUCTION

Ultrasound is the primary imaging modality in obstetrics over the last three decades. The advent of high-resolution transvaginal ultrasound (TVS) has revolutionized our understanding of the pathophysiology and the management of early pregnancy failure. Knowledge of the ultrasound appearances of normal early pregnancy development and a good understanding of its pitfalls are essential for the diagnosis and management of early pregnancy failure.

Ultrasound imaging has rapidly replaced all other techniques used to study normal human development in the first trimester, and ultrasound features of the early gestational sac have corroborated anatomical studies showing that the first structures to appear are the coelomic cavity and the secondary yolk sac. No single ultrasound measurement of the different anatomical features in the first trimester has been shown to have a high predictive value for determining early pregnancy outcome. This prospective correlational study is conducted to assess the correlation of first trimester pregnancy outcome using yolk sac measurements and embryonic heart rate.

Aims & Objectives

2.0. AIMS & OBJECTIVES

A great challenge exists in predicting the first trimester outcome using Ultrasound examination till date. I have chosen this topic as the subject of my study because prediction of first trimester outcome is important for expectant management and counsel the patient for her pregnancy outcome which is the pivotal task in the era of assisted fertility.

- This study is conducted to assess the correlation of patient's first trimester outcome (Normal continuation of pregnancy / Miscarriage) with the yolk sac size and the embryonic heart rate at 6-12 wks gestation.
- To evaluate the association of patient's age, consanguinity, menstrual history, parity and medical illness with first trimester outcome.
- To evaluate the other sonographic parameters like Crown Rump Length and mean sac diameter with first trimester outcome.

Review of the Literature

3.0. REVIEW OF LITERATURE
[1],[2],[3]

"Everything has been thought of before but the problem is to think of it again"

-GOETHE

Ultrasound is defined as the sound above the range of human hearing that is above the frequency of 20,000 Hertz .Normal human hearing frequency range is between 20 Hz – 20,000 Hz . Bats, dolphins and dogs can hear ultrasound.

3.1. HISTORICAL BACKGROUND

History is bunk – but we can learn from it, this is a famous quote of *Henry Ford.* Ultrasound was first demonstrated by *Spellannizine* in 1794 on bats. *Langria* of France used it for detection and destruction of submarines during First World War 1915. It was named SONAR – Sound, Navigation and ranging. It was used to detect flaw in metals and metallic structures like bridges, beams, etc. The first medical use was done by *Dussik* in 1930 for visualization of cerebral ventricles. But his technique was very crude.

Professor *Ian Donald* of Glasgow (1960) reintroduced with much modifications and he is called as the ***"Father of Modern ultrasound".*** He improved the contact between US source and the patient's body by placing the patient in water and finally by smearing the skin with oil or jelly. He insisted on

“full bladder” technique because ultrasound traverses best through fluid medium. The fetus stands as an ideal subject for ultrasound investigation as it remains surrounded by water all time.

Ultrasonography as a technique for determining the foetal gestational age was introduced in the nineteen fifties. In a surprisingly short span of time, development and improvisations in newer technology and research methodology has led to a mind-boggling improvement in assessment of foetal gestation using various parameters.

3.2. BASIC PHYSICS OF ULTRASOUND

Ultrasound uses sound waves between 1 and 30 MHZ. Most obstetric and gynecological applications employ sonic frequencies between 2 and 5 MHZ. the higher the frequency, greater is the attenuation and lesser is the penetration. Mineral oil or gel is applied to the skin to abolish the air tissue interphase. Similarly gas in the intestine blocks the penetration.

3.2.1. Production of ultrasound

The property of *piezo* electricity is the ability of certain crystals to convert one form of energy into another and vice versa.

Electrical energy (change of shape) $\rightleftharpoons$ Mechanical Energy (Mechanical vibration) $\rightleftharpoons$ sound energy

The natural crystal possessing *piezo* electricity is *quartz*, which is now replaced almost entirely by synthetic ceramic crystals such as *barium titenate* and *lead zirconate, titanate*. In medical applications, these crystals are cut into thin wafers and are mounted on a transducer probe.

3.2.2. Ultra sonic technique

1. Pulsed echo technique - provide the location of anatomic structure by measuring the transit time for sound to reach the structure and return to the ultrasonic detection. This is the technique applied in equipment used in this study.
2. Doppler technique: frequency of returning echoes are analyzed to determine the velocity of moving structure.
3. Transmission technique: sound completely traversing the body is analyzed for transit time, intensity, phase shift etc.

3.2.3. Pulsed echo technique Principle

The principle of pulsed echo technique is detection of all returning echoes of short ultra sonic pulses transmitted. The amplitude of each echo depends on the orientation of the reflecting surface and the differences in acoustic impedance of the tissues at the interface. Echoes detected by the transducer are displayed on an

oscilloscope in either **A** mode, **B** mode or **B** scan presentations. The same transducer element is used for both transmitting and receiving.

3.2.4. Types of images

3.2.4.a. A Mode: Amplitude modulation echoes are displayed as vertical deflections from the base line with the height of deflection proportional to the strength of the detected echo.

3.2.4.b. B Mode : In this mode an object is scanned in two axes- longitudinal and transverse. A 2D image of the object is obtained. The image here is made up of bright dots of light. Hence the name brightness mode.

3.2.4.c. M Mode: Motion display consists of B mode in which the baseline is continuously raised. A timed photographic exposure records the movements of anatomic structures.

3.2.5. B Scan: It provides 2 –D cross sectional visualization. B scan is obtained by moving the transducer over the surface of the body and displaying the echoes on the B mode. The transducer is attached to an articulated arm which provides the ultrasound system information on transducer position and orientation. The image in B scan is static. Contact scanning is used in obstetric scans. An acoustic coupling agent like gel is applied to the skin surface and the transducer is manually moved across the skin.

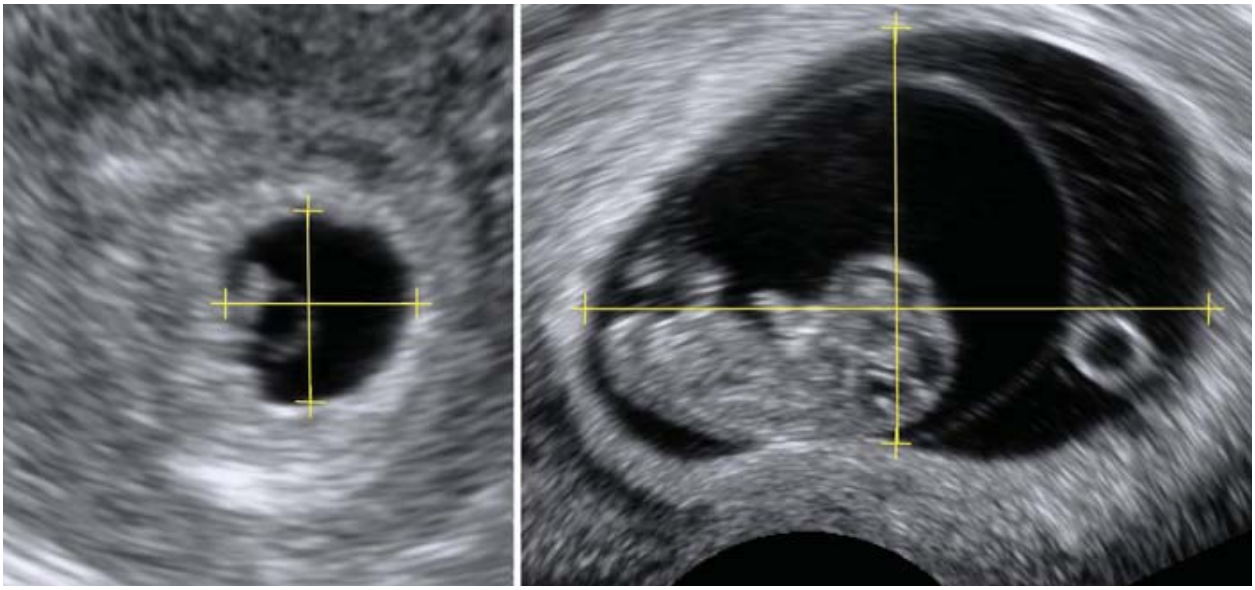
3.2.5.a. Real time B scan:

It is the detection and display of motion as it occurs. Real time systems provide a cinematic view of the area being evaluated by displaying a rapid series of images sequentially.

3.2.5.b. Gray scale

It is a scale for quantification of echo signals to help in the interpretation of an US image. A black and white US image is made up of ‘dot of light’(pixcels) the brightness proportional to the strength of the returning echo. The gray areas of varying intensity which are seen in between the white dots of light signify sonolucent areas.

Ultrasound pictures illustrating the measurements of GSD and CRL.



3.3. PHYSIOLOGY OF HUMAN PLACENTATION

3.3.1. The *in-vivo* anatomy of early pregnancy

The preparation period for the implantation starts shortly after fertilization, during preimplantation period, through both local and systemic signaling. Substances from embryo deposited freely in the uterine lumen are involved in signaling to maternal host and in preparing the site to impending implantation (decidualization). After the blastocyst reaches the uterine cavity, some important changes occur:

1. The zona pellucida is enzymatically loosened by means of a trypsin-like enzyme, secreted by the trophoblast;

2. The blastocyst “hatches” out;

3. The blastocyst attaches by the area above the inner cell mass (embryonic pole) to the endometrial surface epithelia.

4. The next stage of implantation (7th day of development, Carnegie stage 5a) is an active penetration (“invasion”) of the uterine epithe-lium. By that time the trophoblast undergoes its differentiation into inner cellular layer—cytotrophoblast, and outer multinucleated syncytiotrophoblast, which is at the embryonic pole highly invasive.

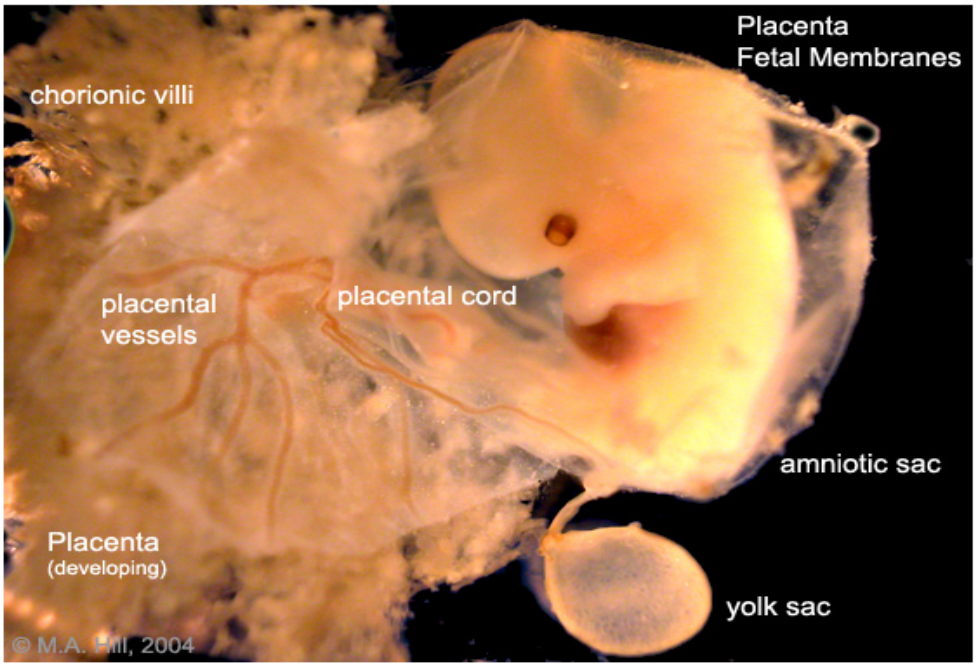
Lacunar or Previllous Stage

By 9th day of development (Carnegie stage 5b) syncytiotrophoblast progresses and invades endometrial stroma. Vacuoles appear in the syncytiotrophoblast at the embryonic pole of the blastocyst. A few vacuoles coalesce and form intercommunicating cavities. Their fluid-filled spaces develop in the lacunae.

Between 10th and 13th days trophoblast pene-trates *deeper* into endometrial stroma and erodes the adjacent maternal capillaries.

Bilaminar Embryonic Disc

During the implantation period and differentiation of the trophoblast, the inner cell mass or embryo-blast rearrange into two epithelial layers: the epiblast or primitive ectoderm and the hypoblast or primitive endoderm. Epiblast and hypoblast form bilaminar embryonic disc. Approximately 7 days after fertilization, amniotic cavity appears. Meanwhile the hypoblast cells migrate along the inner side of the wall of the blastocoele cavity forming the extraembryonic endoderm called **primary yolk sac**. Starting about 12 days after fertilization the extraembryonic mesoderm appears. The extraembryonic mesoderm supports the epithelium of yolk sac and amnion as well as the chorionic villi, which arise from the trophoblast. This mesoderm has an important role in differentiation of the first primitive blood vessels.


Placenta
Fetal Membranes
chorionic villi
placental
vessels
placental cord
amniotic sac
Placenta
(developing)
yolk sac
© M.A. Hill, 2004

Ultrasound imaging has shown that the extrachorionic cavity is the largest anatomical space inside the gestational sac between 5 and 9 weeks of gestation. The development of the ECC is intimately linked with that of the secondary yolk sac (SYS), for which it provides a stable environment. The SYS degenerates spontaneously at around 9–10 weeks, by which time the fetal metanephros has started to function and produce urine which is passed into the amniotic cavity. Subsequently, with the accumulation of this fluid the amniotic membrane moves towards the fetal plate of the placenta, and the ECC will almost entirely disappear by 12–13 weeks of gestation. The development of TVS-guided sampling procedures has allowed direct access to the embryonic fluid cavities. Protein electrophoresis has shown that the celomic fluid results from an ultrafiltrate of maternal serum with the addition of specific placental and SYS bioproducts.

Land marks of normal first-trimester pregnancy

Gestational age	Embryologic change	Sonographic appearance
23 d	Blastocyst implantation	Blastocyst measures 0.1 mm and is too small to visualize
3.5–4 wk	Decidual changes at implantation site	Focal echogenic decidual thickening at implantation site
4–4.5 wk	Trophoblastic tissue	High-velocity and low-impedance trophoblastic flow at the implantation site on TVCFD
4.5–5 wk	Exocoelomic cavity of the blastocyst	Gestational sac (a sonographic term) is always seen when it measures > 5 mm and the serum β-hCG is between 1000 and 2000 mIU/mL (IRP)
5–5.5 wk	Secondary yolk sac	Yolk sac is seen as a thin-walled cystic structure within the gestational sac and should always be seen when the GS is > 10 mm; it is the first sign of a true gestational sac before the visualization of embryo
5–6 wk	Embryo	Seen as a focal echogenic area adjacent to the yolk sac; should always be seen when the GS is > 18 mm
5–6 wk	Embryonic cardiac activity	Embryonic cardiac activity should always be seen when the embryo is > 5 mm; normal heart rate ranges from 100–115 beats/min between 5–6 wk of gestation

Abbreviations: CG, human chorionic goradotropin; GS, gestational sac; IRP, international reference preparation; TVCFD, transvaginal color flow Doppler.

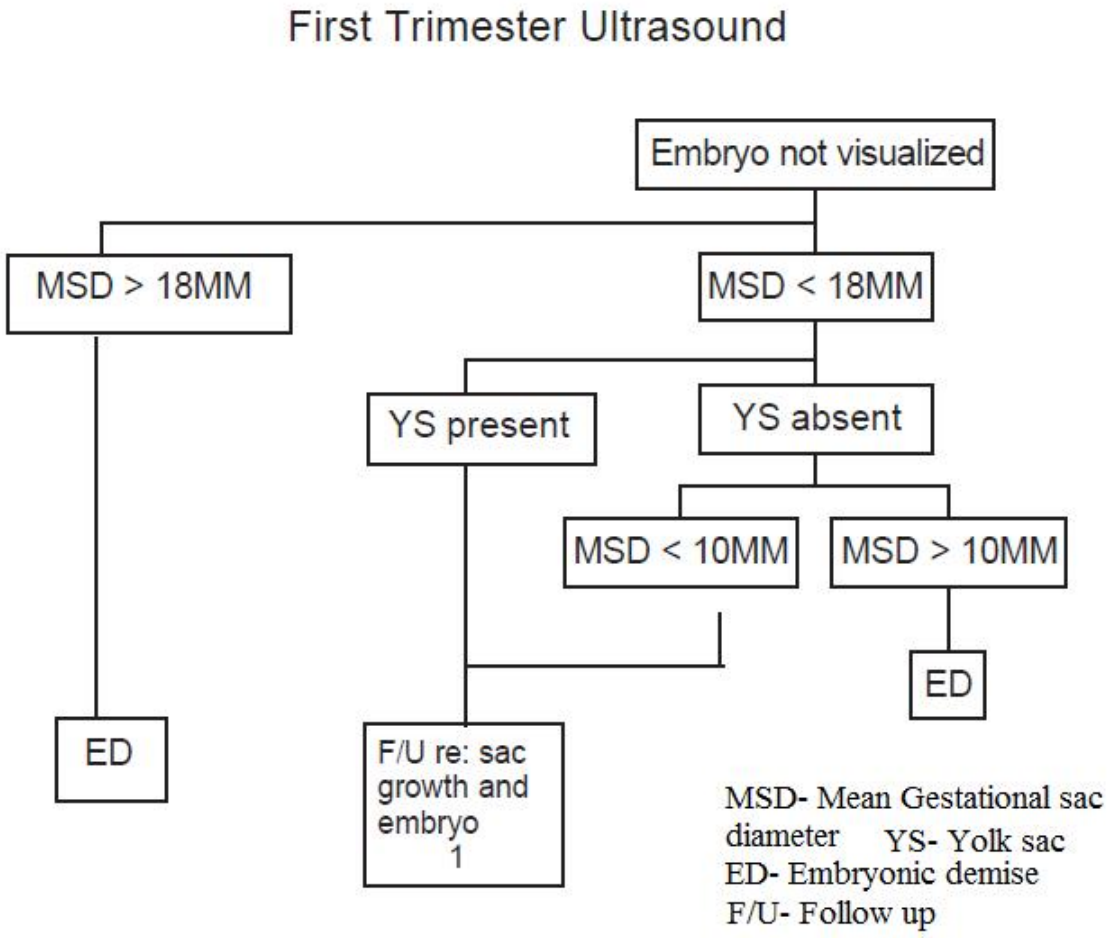
The higher concentrations of human chorionic gonadotropin (hCG), estradiol, estriol and progesterone in the celomic fluid than in maternal serum strongly suggest the presence of a direct pathway between the trophoblast and the ECC. Morphologically, this may be via the villous stromal channels and the loose mesenchymal tissue of the chorionic plate. These findings suggest that the ECC is a physiological liquid extension of the early placenta, and an important interface in fetal nutritional pathways.

3.3.2.The intervillous circulation

Traditionally, it has been assumed that the maternal intraplacental circulation is established soon after implantation, making the human placenta hemochorial throughout pregnancy. However, evidence from morphological studies, hysteroscopy, perfusion of hysterectomy specimens with pregnancy *in situ*, and Doppler/ultrasound studies of the early placenta indicates that significant flow does not occur until the end of the first trimester, at approximately 10 weeks of gestation. This change in blood flow is intimately linked to the extravillous trophoblast migration, for during early pregnancy aggregates of these cells effectively plug the mouths of the spiral arteries, creating a trophoblastic shell between the tip of the spiral arteries and the placental intervillous space. At around the tenth week these plugs start to dissipate, establishing free communications

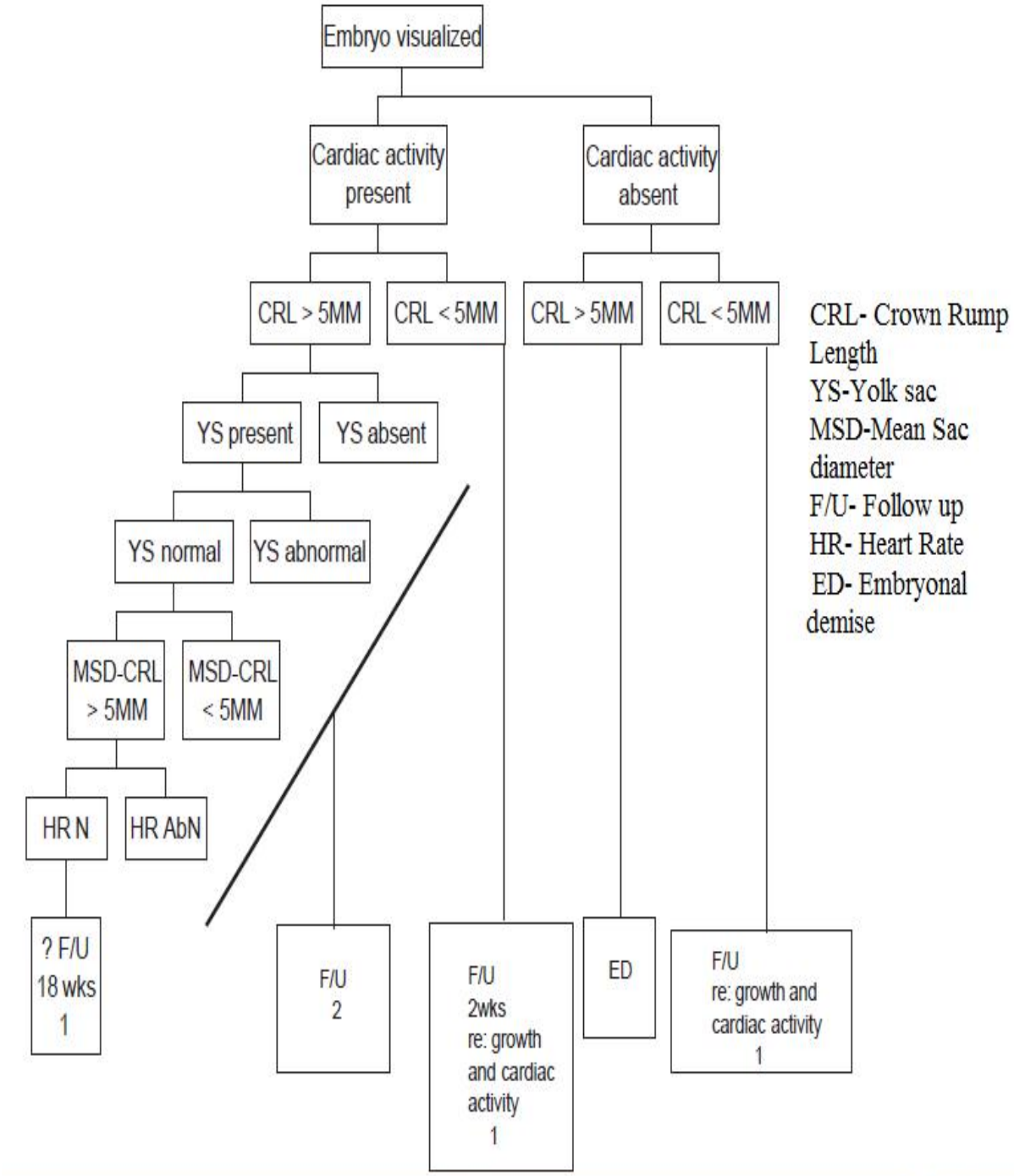
between the spiral arteries and the placenta. The fact that greater trophoblast invasion occurs in the central region of the placental bed suggests that the plugs are more extensive and complete in this region. It might be predicted, therefore, that dissipation of the plugs will occur first at the periphery of the placenta, and our recent Doppler studies have confirmed that this is the case in the majority of normal pregnancies. Thus, if these plugs prevent a continuous flow of maternal blood into the intervillous space during normal early pregnancy, then the human placenta cannot be truly hemochorial until the end of the first trimester. As judged by adult tissue criteria, the human fetus develops in a low oxygen environment. The trophoblastic cells are extremely sensitive to oxidative stress because of their extensive cell divisions and the concomitant exposure of their DNA. There are major changes in placental oxygenation and antioxidant enzymes expression at the transition between the first and second trimesters of pregnancy. This physiological burst of oxidative stress may play an important physiological role in triggering normal placental differentiation. The presence of a gradient between the maternal and fetal tissues is essential as it influences cytotrophoblast proliferation and differentiation along the invasive pathway and promotes villous vasculogenesis. As pregnancy advances between 7 and 16 weeks there is a progressive but independent increase in decidual pO2, which is most probably due to the increase in maternal uterine blood flow volume. As described above, in most normal first-

trimester pregnancies early intervillous flow (i.e. at 8–9 weeks of gestation) is restricted to the peripheral regions of the placenta. This regional physiological oxidative stress is probably the trigger for the formation of the placental membranes. In threatened miscarriage, the maternal symptoms result from a subchorionic hemorrhage or bleed in this peripheral area. In missed miscarriages, however, flow is most common in central regions or throughout the



placenta. These data suggest that the normal establishment of a continuous intervillous circulation is an incremental phenomenon starting in the periphery and

expanding progressively to the rest of the placenta thereafter. This concept is supported by the immunohistochemical and morphological evidence of temporospacial differences in the degree of trophoblastic stress in normal and abnormal early pregnancies. Overall, these ultrasound, anatomical and physiological data provide direct evidence that the architecture of the human first-trimester gestational sac limits fetal exposure to O2, keeping its chemical activity to what is strictly necessary for its development and to minimize the damage caused by oxygen free radicals.


Embryo visualized
Cardiac activity present
Cardiac activity absent
CRL > 5MM
CRL < 5MM
CRL > 5MM
CRL < 5MM
YS present
YS absent
YS normal
YS abnormal
MSD-CRL > 5MM
MSD-CRL < 5MM
HR N
HR AbN
? F/U 18 wks 1
F/U 2
F/U 2wks re: growth and cardiac activity 1
ED
F/U re: growth and cardiac activity 1
CRL- Crown Rump Length
YS-Yolk sac
MSD-Mean Sac diameter
F/U- Follow up
HR- Heart Rate
ED- Embryonal demise

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3.4. ULTRASOUND AND THE PATHOPHYSIOLOGY OF EARLY PREGNANCY FAILURE

Human placentation is more complex than that of other mammalian species, including the higher primates. Abnormalities of placentation are associated with diseases that are almost unique to the human species, such as preeclampsia or hydatidiform mole, or rare in other species, such as miscarriage. Abnormally high or rapidly fluctuating concentrations of oxygen have a harmful effect on tissue and in particular on trophoblastic tissue. There is increasing evidence to indicate that failure of placentation is associated with an imbalance in reactive oxygen species (ROS), which will further affect placental development and function and may subsequently have an influence on both the fetus and its mother.

Maternal metabolic disorders, for example diabetes, which are associated with an increased production of ROS are also known to be associated with a higher incidence of miscarriage and fetal structural defects. Furthermore, the teratogenicity of drugs such as thalidomide has been shown to involve ROS mediated oxidative damage, indicating that the human fetus can be irreversibly damaged by oxidative stress. These findings suggest that fetal development is highly sensitive to disruption by ROS, and hence maintaining a low O2 environment inside the human uterus during early pregnancy may confer protection.

3.4.1. Implantation

There is increasing evidence showing an association between miscarriage and an anomaly of one of the enzymes involved in the metabolism of ROS. These findings suggest that an early pregnancy failure can be due to a primary defect of placentation involving a genetic anomaly of the enzymes or cofactor involved in the metabolism of oxygen. Our recent data on the role of uterine glands in early fetal nutrition suggest that insufficient decidualization could also have an impact on placentation. These glands remain active until at least the tenth week of pregnancy, and their secretions are delivered freely into the placental intervillous space.

An endometrial thickness of 8-14 mm or more is considered to be favorable for embryo implantation. Both adequate endometrial thickness and vascularization are needed for implantation, and women with a good endometrial thickness on ultrasound but a poor intra-endometrial blood flow tend to have a poor reproductive outcome. It has been suggested that uterine artery impedance plays an important role in endometrial receptivity prior to implantation. Delay in the normal lowering of uterine arterial resistance may result in impaired endometrial function and recurrent miscarriage. Use of Doppler assessment of the uterine vasculature may be useful in determining optimal endometrial receptiveness in assisted reproduction cycles.

3.4.2. Miscarriage and placental blood flow

There is substantial anatomical evidence that in the majority of cases, the most common complications of pregnancy (i.e. spontaneous miscarriage and preeclampsia) stem from a defect in early trophoblast invasion and a failure to convert the spiral arteries into low-resistance channels. In about two thirds of early pregnancy failures there is anatomical evidence of defective placentation, which is mainly characterized by a thinner and fragmented trophoblast shell, and reduced cytotrophoblast invasion of the lumen at the tips of the spiral arteries. This is associated with premature onset of the maternal circulation throughout the placenta in most cases of miscarriage. These defects are similar in euploid and most aneuploid miscarriages, but are more pronounced in triploid partial moles. In complete hydatidiform mole the extravillous trophoblast invasion into the decidua and superficial myometrium is almost entirely absent. The syncytiotrophoblast degeneration/regeneration is probably most extensive in cases of missed miscarriage, in which maternal blood flow is premature and widespread.

The excessive entry of maternal blood into the intervillous space has a direct mechanical effect on the villous tissue and an indirect oxidative stress effect, which contributes to cellular dysfunction and/or damage. Complete loss of syncytiotrophoblast function through oxidative stress would, of course, lead to a precipitate fall in hCG concentration, and hence to early pregnancy failure.

Oxidative stress is well known to initiate the caspase cascade leading to cell death in other systems. Generation of ROS in large quantities, such as in maternal diabetes, in the first-trimester placenta, which has limited antioxidant defenses, may cause DNA damage and oxidation of proteins and lipid resulting in extensive cell death. Apoptosis has been found to be intensified in cases of miscarriage and concentrations of lipid peroxides increase in the decidua of women undergoing early pregnancy loss. The celomic fluid in missed miscarriages has also been investigated but has only provided limited information on the mechanisms of early pregnancy failure.

The fluid collected in anembryonic pregnancies is of exocelomic origin and its biochemical characteristics reflect a failure of most placental biological mechanisms such as metabolic function, transport function and endocrine activity. These findings support the concept that embryonic and placental development are closely related in the first trimester of human pregnancy, placental biological functions persisting only for a limited period of time after embryonic demise. Normal or high maternal serum alpha-fetoprotein (AFP) levels and AFP molecules predominantly of yolk sac origin in the celomic fluid of pregnancies with an empty gestational sac on ultrasonography provide further evidence that the most likely explanation for this feature is the early death of the embryo with persistence of the placental tissue. The uteroplacental circulation is a dynamic model in which the

magnitude of blood flow through a single vessel may vary significantly, therefore the evaluation of blood flow in single uteroplacental vessels is often difficult to interpret and is of limited value in understanding the pathophysiology of placental-related disorders of pregnancy. Recent work has suggested that although Doppler sonography in early pregnancy has not been found to be a useful screening tool for placental-related disorders such as pre-eclampsia and growth restriction, there may be a role for its use towards the end of the first trimester. These findings clearly need further investigation, as the discovery of a non-invasive screening test for disorders of placental function early in pregnancy remains elusive.

3.4.3. Threatened miscarriage

Threatened miscarriage occurs in 15–20% of viable pregnancies and is one of the commonest gynaecological emergencies. In the past, much emphasis has been placed on the volume of an intrauterine hematoma (IUH) or on the presence of vaginal bleeding but not on the location of the hemorrhage. It is likely if the bleeding occurs at the level of the definitive placenta (under the cord insertion) it may result in placental separation and subsequent abortion. Conversely, an IUH that only detaches the membrane a distance away from the cord insertion can probably reach a significant volume before it affects normal pregnancy development by a direct volume pressure effect. The presence of a hematoma may also be associated with a chronic inflammatory reaction in the decidua, resulting in

persistent myometrial activity and expulsion of the pregnancy. As mentioned previously, in about two-thirds of early pregnancy failures there is defective placentation which is mainly characterized by a thinner and fragmented trophoblast shell, and reduced cytotrophoblast invasion of the lumen at the tips of the spiral arteries. The development of a hematoma may be the first sign of an incomplete placentation and be associated with acute oxidative stress, which may impair subsequent placental and membrane development. A delicate balance is probably achieved between the production of free radicals and protective antioxidant activity in early pregnancy. Any change in this equilibrium, resulting in an increase in free radical formation, such as a premature influx of oxygenated maternal blood, the presence of substances which form free radicals or a reduction in local antioxidant levels, may well result in an impairment in placentation, and subsequent pregnancy complications, from miscarriage at one end of the spectrum and preterm premature rupture of membranes (PPROM) and preeclampsia at the other. There is already mounting evidence of a role for free radical damage in PPROM and preeclampsia, however, its role in miscarriage is only recently emerging. The excessive entry of maternal blood inside the membranes, if located near the placenta, may have a direct mechanical effect on the villous tissue, and an indirect oxidative stress effect which contributes to cellular dysfunction and/or damage.

3.5. ULTRASOUND AND THE DIAGNOSIS OF MISCARRIAGE

The use of TVS has clearly revolutionized the management of early pregnancy problems. The development of highly sensitive urinary hCG assays and greater awareness of early pregnancy ultrasound amongst health care professionals and women alike has resulted in ever earlier presentation. This has led to an increase in the number of inconclusive scans and as a result an increase in the requirement for repeat assessments to determine both pregnancy location and viability. Knowledge of the typical ultrasound appearances of normal early pregnancy development and a good understanding of its pitfalls is essential for the diagnosis and management of early pregnancy failure. Use of appropriate terminology to describe clinical and ultrasound findings in early pregnancy failure is also essential, and the use of obsolete terms such as blighted ovum, anembryonic sac and trophoblastic bleeding should be abandoned. Such descriptions are of limited clinical usefulness and have no histopathological correlates and have therefore been replaced by more ultrasound-based terminology.

Ultrasound-based terminology used in the diagnosis of miscarriage

Diagnosis	*Ultrasound appearance*	*Clinical presentation*
Complete miscarriage	Endometrial thickness < 15 mm ; no evidence of retained products of conception	Cessation of vaginal bleeding and abdominal pain
Incomplete miscarriage	Any endometrial thickness; heterogeneous tissues (± sac) distorting midline endometrial echo	± Bleeding and/or abdominal pain
Delayed miscarriage (previously anembryonic/missed)	Gestational sac diameter ≥ 20 mm with no fetal pole or yolk sac (or < 20 mm with no change 7 days apart) *or* fetal pole > 6 mm with no fetal heart activity (or < 6 mm with no change 7 days apart)	Minimal vaginal bleeding or pain; loss of pregnancy symptoms
Intrauterine hematoma	Crescent-shaped, echo-free areas between the chorionic membrane and the myometrium	± Vaginal bleeding

3.5.1. Gestational sac

The inner cell mass: A group of blastomeres that give rise to the embryo.

On day 20 of the cycle the blastocyst attaches to the endometrium usually on the site of the inner cell mass.

The trophoblast starts to proliferate rapidly and differentiate into two layers:

• Cytotrophoblast: Inner layer of cells.

• Syncytiotrophoblast: Outer layer of cells.

The Syncytiotrophoblast extends through the endometrium and invades the endometrial connective tissue. By day 21 of the menstrual cycle the blastocyst is superficially implanted, and by day 23 it is completely implanted into the endometrium. Isolated cavities called lacunae appear in the Syncytiotrophoblast, the uterine vessels erode and come in contact with these lacunae to build the beginning of the uteroplacental circulation. The Syncytiotrophoblast begins to produce a hormone, the human chorionic gonadotrophin (hCG), which enters the

aforementioned lacunae to the maternal blood. As the conceptus implants, cells of the endometrium swell because of accumulation of glycogen and lipids. These changes in the endometrium are known as the decidual reaction.

ULTRASOUND FINDINGS

By the time the blastocyst is implanted in the endometrium, the conceptus measures 0.1 mm and cannot be detected by the available ultrasound equipment. More reliable evidence of the presence of pregnancy is the demonstration of trophoblastic flow with Transvaginal Color Flow Doppler (TVCFD),[7,8] which is characterized by a high-velocity, low-impedance signal. It has been suggested that the increased blood flow velocity in the endometrium is due to the invasion of the decidua by the chorionic villi.[10] The peak flow velocity in a normal pregnancy ranged from 8 to 30 cm/sec before TVS visualization of the intradecidual sac.

The deciduo-placental interface and the ECC are the first sonographic evidence of a pregnancy that can be visualized with TVS from around 4.4–4.6 menstrual weeks (32–34 days) when they reach together a size of 2–4 mm. In normal intrauterine pregnancies between the fifth and sixth weeks, the gestational sac grows at a rate of approximately 1 mm/day in mean diameter. Gestational sac growth has been documented on serial ultrasound examinations to be slower in women who subsequently miscarry; however, it has long been recognized that there is wide scatter in gestational sac volume measurements in ‘normal’ early

pregnancy. Once a gestational sac has been documented on ultrasound, subsequent loss of viability in the embryonic period remains around 11%. A smaller than expected gestational sac can be a predictor of poor pregnancy outcome,
both alone and in combination with other parameters, even in the presence of embryonic cardiac activity. In very early pregnancy, there appears to be no difference in gestational sac diameter (GSD) when compared with pregnancy outcome69, the difference only becoming apparent from 5 weeks onwards. Unfortunately, the predictive value of a smaller than expected GSD in isolation
is variable and highly dependent upon other presenting factors. Interpretation of pregnancy outcome data for any variable in early pregnancy is hampered by significant differences in study design and entry criteria.

Gestational sacs are usually round, but as they grow they frequently become
elliptic and they may get irregular in shape as a result of:

• Uterine myoma

• Uterine contraction

• Bleeding surrounding the implantation site

• Distended maternal bladder

Table demonstrates how published study populations vary, including low-risk, asymptomatic women, women with threatened miscarriage and women

undergoing assisted conception techniques. Demographic data are often not accounted for and clearly these data should not be directly compared, and findings should not be applied to all populations. Studies involving women undergoing assisted conception are likely to be most accurate in terms of precise dating of the pregnancy, particularly as miscarriage rates for such pregnancies are now believed to be comparable to the fertile population. Overall, multivariate analyses appear to provide the most sensitive predictors of pregnancy outcome and GSD features strongly in combination with one or two other parameters in all of these models. Small gestation sac size can also be associated with chromosomal abnormality. Triploidy and trisomy 16 are more often associated with a small chorionic sac before 9 weeks' gestation than other chromosomal abnormalities.

3.5.2. Crown–rump length

The now classical study by Robinson and Fleming on crown–rump length (CRL) is still the main reference for the assessment of gestational age in early pregnancy. Because TVS provides superior resolution and more accurate identification of the embryonic structures than abdominal ultrasound, new charts have been developed for the period of gestation before 7 weeks. In a normal pregnancy the amnion may be visualized when the crown-rump length is 5 mm and is routinely detectable

when the CRL is 7 mm or more. From this age onwards the amniotic sac diameter as well as the CRL increase by 1 mm per day.

The risk of early pregnancy loss relation to CRL values

CRL *(mm)*	*Possibility for pregnancy loss (%)*
<5	8
6–10	3–4
>10	below 1

If an embryo has developed up to 5 mm in length, subsequent loss of viability occurs in 7.2% of cases. Loss rates drop to 3.3% for embryos of 6–10 mm and to 0.5% for embryos over 10 mm.

There is conflicting evidence for an association between early growth restriction, as defined by a deficit between the CRL and that predicted by the last menstrual period, and karyotypic abnormalities. A smaller than expected CRL has, however, been associated with subsequent miscarriage. Mean GSD:CRL ratios have also been used to predict pregnancy outcome with varying degrees of accuracy. Unfortunately this technique, as is the case for GSD measurements, is of limited clinical usefulness in isolation.

3.5.3. Secondary yolk sac

The first structure to be seen inside the gestational sac, before the embryo itself, is the SYS which can be observed from the beginning of the fifth week of

gestation or when the gestational sac reaches 10 mm in diameter. The SYS diameter increases slightly between 6 and 10 weeks' gestation and then decreases. The comparison of ultrasound features with morphological findings indicates that when the SYS reaches its maximum sonographic size, it already shows important degenerative changes. This suggests that the disappearance of the SYS in normal pregnancies is a spontaneous event in embryonic development rather than the result of mechanical compression by the expanding amniotic cavity. The predictive value of SYS measurements in determining the outcome of an early pregnancy is limited, most pregnancies which miscarry during the third month of pregnancy have normal SYS measurements at their initial scan before 8 weeks of gestation. It is usually the yolk sac that is found to persist inside the gestational sac after embryonic demise. This would suggest that variations in SYS size and sonographic appearance in most abnormal pregnancies are probably the consequence of poor embryonic development or embryonic death rather than being the primary cause of early pregnancy failure.

3.5.4. Fetal heart pulsation

Extensive research has been published examining the predictive value of fetal heart activity on pregnancy outcome. Studies can be broadly divided into those examining fetal loss after confirmed fetal cardiac activity, and those examining fetal heart rate (FHR) in relation to outcome. Fetal heart activity is the

earliest proof of a viable pregnancy and it has been documented *in utero* by TVS as early as 36 days' menstrual age, approximately at the time when the heart tube starts to beat. Theoretically, cardiac activity should always be evident when the embryo is over 6 mm. However, in around 5–10% of embryos between 2 and 4 mm it cannot be demonstrated, although the corresponding pregnancies will have a normal outcome. From 5 to 9 weeks of gestation there is a rapid increase in the mean heart rate from 110 to 175 beats per minutes (bpm). The heart rate then gradually decreases to around 160–170 bpm. Abnormal developmental pattern of FHR and/or bradycardia has been associated with subsequent miscarriage. In particular, a slow FHR at 6–8 weeks appears to be associated with subsequent fetal demise.

A single observation of an abnormally slow heart rate does not necessarily indicate subsequent embryonic death, but a continuous decline of embryonic heart activity along with irregularity is inevitably associated with miscarriage In women with recurrent spontaneous miscarriage (defined a three or more consecutive losses in the first trimester) there has been much debate regarding whether there is an increased likelihood that fetal heart pulsations will be seen on TVS when compared with idiopathic spontaneous miscarriages, suggesting a different pathophysiology leading to pregnancy loss in these cases. Evidence

would suggest, however, that fetal loss patterns are no different between these groups.

3.5.5. Other sonographic features

The shape of the gestational sac, the echogenicity of the placenta, the thickness of the trophoblast and the presence of an intrauterine hematoma have all been proposed as sonographic markers associated with early spontaneous miscarriage. Many of these studies, however, often highlight problems with experimental design rather than providing unequivocal answers. IUHs are crescent-shaped, echo-free areas between the chorionic membrane and the myometrium. Understanding of the resolution of these hematomas and the prognostic relevance of this ultrasound finding are limited. Many authors have previously focused on an association between the size of the hematoma and subsequent obstetric complications. Overall, the presence of an IUH has been associated with a 4–33% rate of miscarriage depending on the gestational age at which the complication was described. Conversely, threatened miscarriage symptoms at 7–12 weeks, even in the presence of detectable fetal cardiac activity, is not only associated with a 5–10% miscarriage rate before 14 weeks of gestation but also with adverse pregnancy outcome at later gestations. In particular, women with bleeding in the second half of the first trimester are at higher risk of PPROM and preterm labor. These risks are independent of the presence or absence of an IUH on the initial ultrasound

examination and would suggest that threatened miscarriage in the first trimester is a risk factor for adverse pregnancy outcome regardless of the ultrasound findings.

3.5.6. Color Doppler imaging

The ability of transvaginal color Doppler imaging to detect FVWs from small vessels such as the terminal part of the uteroplacental circulation has given rise to much enthusiasm from clinicians interested in predicting early and late pregnancy complications related to an abnormal placentation. Overall, the predictive value of Doppler measurements of resistance to blood flow in early pregnancy is limited. All Doppler studies in the first trimester have failed to demonstrate abnormal blood flow indices in the uteroplacental circulation of pregnancies that subsequently ended in miscarriage. Histological assessment of decidual endovascular trophoblast invasion in first-trimester pregnancies about to undergo therapeutic evacuation, with low- and high resistance umbilical artery Doppler measurements, has shown that although the proportion of vessels invaded is increased in women with low-resistance Dopplers, invasion is normal in both groups. A comparison of uterine and intraplacental blood FVWs with pathological features in missed miscarriages and normal pregnancies has shown that in the former the mean pulsatility index is higher and the intervillous flow premature and increased. These findings are associated with abnormal placentation and dislocation of the trophoblastic shell and are only found when the process of miscarriage is established and irreversible.

Studies did not show any difference in terms of RI and PI of the intervillous arterial blood flow between women with missed abortion and those with normally developing pregnancy. Being aware that chromosomal abnormalities are one of the most important factors for spontaneous abortion occurring uterine artery does not have any clinical role in the management of early pregnancies complicated by uterine bleeding. Analyzing intervillous circulation as one of the first ultrasonographic signs of the pregnancy, studies demonstrated lower vascular resistance of the arterial-like signals in the patients with blighted ovum when compared with the normal pregnancies.

3.5.7. Three-dimensional ultrasound

The emergence of three-dimensional (3D) ultrasound in obstetrics provided an opportunity to revisit previously abandoned or disregarded obstetric ultrasound parameters, particularly in early pregnancy. 3D assessment of gestational sac volume in the first trimester has been found to be a sensitive indicator of pregnancy outcome, with a smaller than expected gestational sac volume being predictive of failing early pregnancy. It has not, however, proved useful in determining the outcome of expectant management or in predicting the success of medical treatment and appears to add little to the diagnostic or prognostic value of two-dimensional imaging.

G.Acharya et al in 2002 used 3-D ultrasound volumetry of intrauterine contents in cases of normal and failed pregnancies and positively correlated these with the conventional 2-D measurements. *Marc sutterlin et al* gained insight into this comparison and found 3D to be superior to 2D volumetry. *E Janniaux et al* threw lights on predicting pregnancy outcome by using color Doppler which failed to demonstrate normal blood flow indices in pregnancies that subsequently ended in miscarriage.

Babinszhi et al in June 2001 used 3-D measurement of yolk sac and gestational sac as predictors of pregnancy outcome in first trimester. Volumetry of G-sac proved to be a sensitive predictor of pregnancy outcome and a good supplement to CRL measurement.

3.6. THE YOLK SAC

The yolk sac appears as a circular transonic mass within the gestation sac and first be identified transvaginally at about 35 days, when it measures 3–4 mm in diameter . At this stage it is significantly larger than the embryo. It is a prominent landmark to search for within the early gestation sac and, because of its close association with the embryo at this stage, identifying it will automatically lead to the embryo.

It is well known that the yolk sac is responsible for the execution of nutritional, endocrine, metabolic, immunologic, and hematopoietic functions

during organogenesis until establishment of the placental circulation. Because the yolk sac is of vital importance for embryologic development, a sonographic examination of an early pregnancy should include its assessment. Transvaginal sonography allows more detailed visualization of the yolk sac during early pregnancy. A sonographic examination should show the yolk sac before the diameter of the gestational sac becomes 8 mm in length.

The yolk sac grows slowly until it reaches a maximum diameter of 6mm at 10 weeks. The yolk sac floats freely in the chorionic cavity until the increasing size of the amniotic sac compresses it against the wall of the chorionic cavity. This factor makes identification of the yolk sac difficult after about 12weeks. Furthermore, in cases of missed abortion with a visible embryo, the yolk sac tends to be larger and its wall is thinner than in normal pregnancies

. • Too large—more than 6 mm (over 2SD, sensitivity 16%, specificity 97%, PPV60%),

• Too small—less than 3 mm (below 2SD, sensitivity 15%, specificity 95%, PPV 44%),

• Irregular shape—mainly wrinkled with indented walls,

• Degenerative changes—abundant calcifications with decreased translucency of the yolk sac .

• Number of yolk sacs—has to be equal to the number of the embryos

Currently, the major benefits of the sonographic evaluation of the yolk sac are:

1. Differentiation of potentially viable and nonviable gestations,

2. Confirmation of the presence of an intrauterine pregnancy vs. a decidual cast, and

3. Indication of a possible fetal abnormality.

	Yolk sac characteristics	
	Normal yolk sac	*Abnormal yolk sac*
Size	5–6 mm up to 9th week of gestation	< 2 mm in 8 to 12 weeks (to small) > 6 mm after 10th week (to large)
Shape	Round	Oval, distorted
Ultrasound finding	Echoic rim, hypoechoic center	Hyperechoic
Doppler	Absence of diastolic flow	Irregular blood flow Permanent diastolic flow Venous blood flow

3.7. THE EMBRYO:

Embryologically, the period from conception to the end of the ninth postmenstrual week is known as the ‘embryonic period’. The remaining 30 weeks

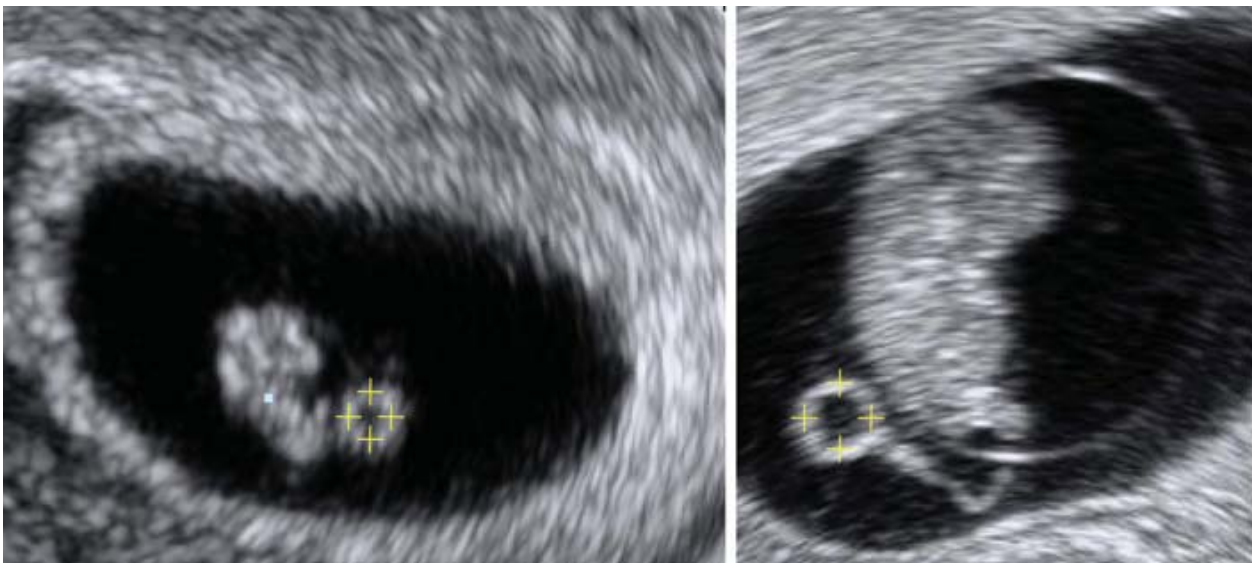


Fig: 2, Ultrasound pictures illustrating the measurement of YSD in embryos with CRL of 8 mm (left) and 22 mm (right). The callipers are placed at the centre of the yolk sac wall.

of pregnancy comprise the ‘fetal period’. The embryo can be visualized from about 37days using the transvaginal route and is first seen as a bright linear echo, adjacent to the yolk sac and close to the connecting stalk. At this stage, the crown–rump length (CRL) measures around 2 mm. Cardiac activity can be identified. When the embryo reaches 5 mm in length, equivalent to 6+3 weeks’ gestation and a mean sac diameter of 15–20 mm, it can be consistently seen separate from the yolk sac. The embryo grows at around 1 mm per day.

3.8. EMBRYONIC HEART RATE

All embryos of CRL >6 mm in length should demonstrate visible cardiac activity. Once an embryo with visible heart action is seen, the pregnancy is viable. Normal ranges for fetal heart rate in pregnancy have been described showing a rapid increase of the mean heart rate between 6 and 9 weeks followed by a slight decline after 10 weeks. It has been shown that a late onset of cardiac activity and a decreased heart rate in the first trimester are associated with a higher rate of spontaneous abortion.

Lindsay and co-workers showed that the yolk sac in normal pregnancies and showed that a yolk sac diameter outside the 95% confidence limits was frequently

associated with a poor pregnancy outcome. *G.Makrydimas et al* on Sep 2003 examined the value of ultrasound findings in the prediction of subsequent fetal loss and pregnancies with live fetuses at 6-10 weeeks gestation and found correlation with G-sac diameter and fetal heart rate.

Online publication by *T.Kucuk et al* showed that yolk sac diameter of 2SD of the mean for the menstrual age allowed prediction of an abnormal pregnancy outcome. *Cepni et al* observed that when discrepancy is detected between secondary yolk sac diameter and gestational age it had an abnormal outcome.

Relationship between embryonic CRL and GA, embryonic HR, mean GSD and YSD

CRL mm	Gestation, days			Embryonic HR, bpm			GSD, mm			YSD, mm		
	50th	5th	95th	50th	5th	95th	50th	5th	95th	50th	5th	95th
1	41	38	44	99	85	113	12.9	8.1	18.7	3.2	2.4	4.1
2	42	39	46	104	90	119	13.9	9.0	20.0	3.3	2.5	4.2
3	43	40	47	109	94	125	15.0	9.9	21.3	3.4	2.6	4.3
4	44	41	48	114	99	130	16.1	10.8	22.6	3.5	2.7	4.4
5	45	42	49	119	104	135	17.2	11.7	23.9	3.6	2.7	4.5
6	47	43	50	124	108	140	18.4	12.6	25.2	3.6	2.8	4.6
7	48	44	51	129	113	145	19.5	13.5	26.5	3.7	2.9	4.7
8	49	45	52	133	117	150	20.6	14.5	27.8	3.8	2.9	4.8
9	50	46	53	137	121	155	21.7	15.4	29.1	3.9	3.0	4.8
10	51	47	54	141	125	159	22.8	16.3	30.4	3.9	3.1	4.9
11	52	48	55	145	128	163	23.9	17.3	31.7	4.0	3.1	5.0
12	53	49	56	149	132	167	25.0	18.2	32.9	4.1	3.2	5.1
13	54	50	57	152	135	171	26.1	19.1	34.2	4.2	3.3	5.2
14	55	51	58	156	138	174	27.2	20.0	35.4	4.2	3.3	5.2
15	56	52	59	159	141	177	28.2	21.0	36.6	4.3	3.4	5.3
16	57	53	60	161	144	180	29.3	21.9	37.8	4.3	3.4	5.4
17	58	54	61	164	146	183	30.3	22.7	38.9	4.4	3.5	5.4
18	59	55	62	166	148	185	31.3	23.6	40.1	4.5	3.5	5.5
19	59	56	63	168	150	187	32.3	24.4	41.2	4.5	3.6	5.6
20	60	57	64	170	151	189	33.2	25.3	42.2	4.6	3.6	5.6
21	61	58	65	171	153	190	34.1	26.1	43.3	4.6	3.7	5.7
22	62	59	66	172	154	192	35.0	26.8	44.3	4.7	3.7	5.7
23	63	60	66	173	154	192	35.9	27.6	45.2	4.7	3.8	5.8
24	64	60	67	173	155	193	36.7	28.3	46.2	4.8	3.8	5.8
25	65	61	68	174	155	193	37.5	29.0	47.0	4.8	3.8	5.9
26	66	62	69	174	155	193	38.2	29.7	47.9	4.8	3.9	5.9
27	66	63	70	173	155	193	39.0	30.3	48.7	4.9	3.9	6.0
28	67	64	71	173	154	192	39.6	30.9	49.5	4.9	3.9	6.0
29	68	64	71	172	153	191	40.3	31.5	50.2	4.9	4.0	6.0
30	69	65	72	170	152	190	40.9	32.0	50.8	5.0	4.0	6.1
31	69	66	73	169	151	188	41.5	32.5	51.5	5.0	4.0	6.1
32	70	67	74	167	149	186	42.0	33.0	52.1	5.0	4.0	6.1
33	71	68	74	165	147	184	42.5	33.4	52.6	5.0	4.0	6.1
34	72	68	75	163	145	182	42.9	33.8	53.1	5.1	4.1	6.2
35	72	69	76	160	142	179	43.3	34.1	53.5	5.1	4.1	6.2
36	73	70	77	157	140	176	43.6	34.4	53.9	5.1	4.1	6.2
37	74	70	77	154	137	173	43.9	34.7	54.2	5.1	4.1	6.2
38	74	71	78	151	134	169	44.2	34.9	54.5	5.1	4.1	6.2
39	75	72	79	147	130	165	44.4	35.1	54.7	5.1	4.1	6.2
40	76	72	79	144	127	161	44.6	35.3	54.9	5.1	4.1	6.2

Materials & Methods

4.1. MATERIALS

Period of study: December 2010 to November 2011

Material: First trimester antenatal cases who were attendees of Govt. RSRM Lying-in Hospital attached to Stanley medical college, Chennai.

Inclusion criteria:

1. Antenatal patients with single gestation and live embryo
2. Age < 30yrs

Exclusion criteria:

1. Pregnancy from infertility treatment
2. Cases without embryonic heart rate, anembryonic pregnancy, subchorionic haemorrhage and inconsistency between gestational sac size and CRL.
3. Women who has used any abortive or teratogenic drugs

4.2. METHODS

It is a prospective study conducted at government RSRM –lying in hospital attached to Stanley medical college, Chennai during A total of 120 antenatal women were included in the study belonging to first trimester. Women attending routine antenatal check up in the out-patient department were subjected to scan.

Only those antenatal women who were <30 years and of singleton pregnancy were included in the study. The study included both primigravida and

multigravida. No socio-economic categorization was made. Patient with history of intake of teratogenic drugs, without embryonic heart rate, anembryonic pregnancy, subchorionic haemorrhage and inconsistency between gestational sac size and CRL were excluded from the study.

A detailed history was elicited with special reference to the last menstrual period, its regularity and other associated risk factors like diabetes mellitus, hypertension, hypothyroidism, cardiac disease and bronchial asthma. Then a thorough general, physical, systematic and obstetric examination was carried out. After obtaining informed consent the women between 6-12 weeks of gestation were subjected to transvaginal ultrasound.

4.2.1. MACHINE:

All examination were performed using linear array real time B scan with 7.5 MHz transducer.

4.2.2. MEASUREMENT OF GESTATIONAL SAC:

After asking the patient to empty her bladder a small amount of gel is applied to transducer tip and covered by a condom. A true saggital view of the uterus obtained and the transducer is 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 transducer is rotated to 90 degree to obtain the cross section of sac and the

maximum transverse diameter is measured. By transvaginal approach abnormal gestational sac criteria include:

• Impossibility to detect yolk sac when sac diameter is 8 mm or greater, or

• Impossibility to detect cardiac activity when sac diameter is 16 mm or greater.

When growth rate fails to increase at least 0.7 mm/day, abnormal sac and early embryo failure should be considered.

Pseudogestational sac is characterized by either absent flow around it or very low velocity flow (<8 cm/s peak systolic velocity) and moderate resistance to blood flow (RI>0.50). Normal or abnormal intrauterine gestational sac is characterized by high velocity and low resistance pattern (RI<0.45).

Measurement of the gestational sac volume by 3D US can be used for the estimation of gestational age in the early pregnancy. An abnormal measurement of gestational sac could potentially be used as a prognostic marker for pregnancy outcome.

4.2.3. MEASUREMENT OF YOLK SAC:

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. Any yolk sac with totally smooth and no deformed margins was defined as having regular shape. The yolk sac with mainly wrinkled margins, indented walls was identified as having irregular shape.

4.2.4. MEASUREMENT OF EMBRYONIC HEART RATE:

Heart rate – in the first trimester the measurement of heart rate should be performed using turnover M-mode. The heart rate increases rapidly from six to eight weeks and then remains relatively stable afterwards.

4.2.5. MEASURE MENT OF CROWN RUMP LENGTH:

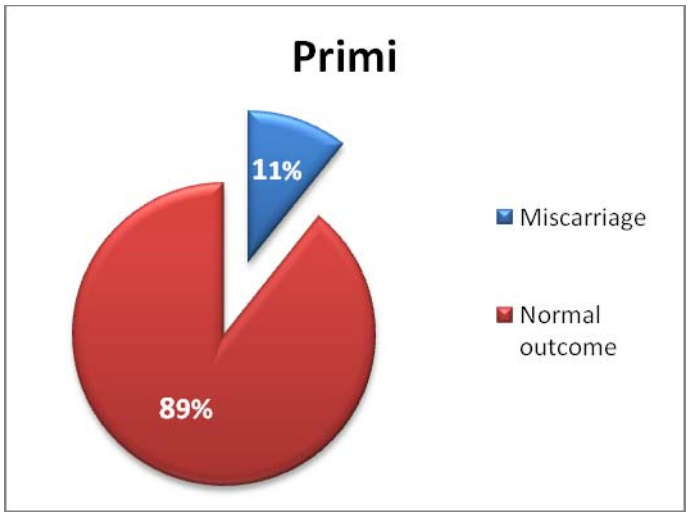
A correctly performed measurement of CRL is the most accurate means of estimating the gestational age. An optimal CRL image, accurately measured, is more accurate in dating a pregnancy. It is measured by obtaining a true, unflexed, longitudinal section of the embryo or fetus, with the end-points of the crown and rump clearly defined, and then placing the calipers correctly on these defined end-points. Three measurements are taken and the average of them is taken as the crown rump length.

Results & Observation

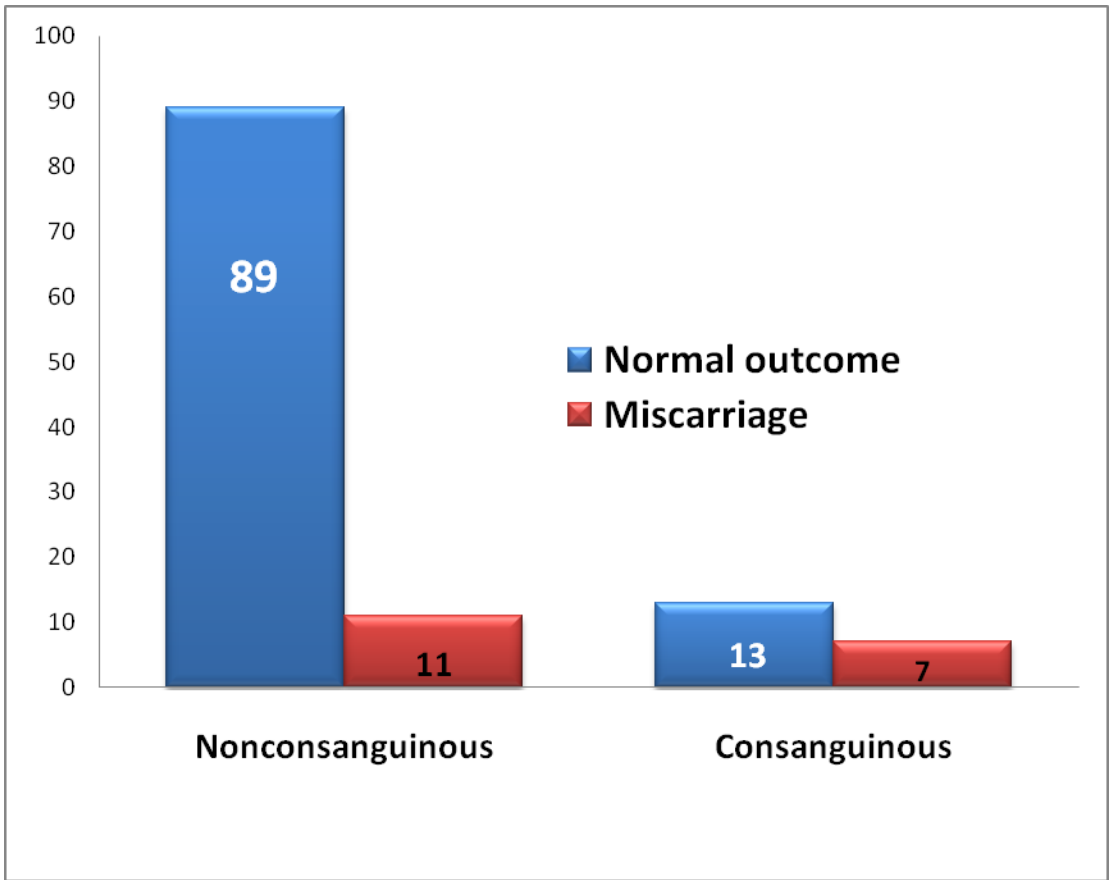
5.0. RESULTS

In our study 120 first trimester pregnant cases, who attended RSRM Lying in hospital, Royapuram were included as per criteria and data collected. The first trimester pregnancy outcome was evaluated by miscarriage or normal continuation of pregnancy.

Age at the time of pregnancy and first Sonogram correlates with the first trimester pregnancy outcome (*One way ANOVA* p=0.028*). Mean age was 23.73 years with minimum 16 years and maximum of 36 years. Regarding parity, primi to multipara women were included. In parity analysis Primi para were 84 cases. Among primi, 9 had miscarriage other 75 had normal pregnancy. As the number of previous abortions increases the chances of miscarriage also increases (*Pearson Chi-square test* p=0.043*).



Regarding marital status consanguinous marriage correlates with Miscarriage. Non consanguineous marriage was among 100 cases and third degree consanguineous marriage in 20 patients. In the normal outcome patients, non-consanguinous marriage is in 89 cases (87.3%) and consanguinous marriage is in 13 cases (12.7%). Among eighteen miscarriage cases 11 (61.1%) were non consanguinous marriage, 8 (38.9%) were consanguinous marriage. Consanguinity has highly significant correlation with pregnancy outcome (*Pearson Chi-square test* p=0.006**).



Number of years since married ranges between 0.3 and 7.0 years, with mean years of 2.06 and it has significant correlation with pregnancy outcome (*T-test and* p=0.025*).

In our study 108 cases were without medical illnesses and about 12 cases with associated one of the medical illness. Medical illnesses were Systemic hypertension, polycystic ovary disease (PCOD), Diabetes Mellitus, Bronchial Asthma, Anemia and Hypothyroidism. Among cases without medical illness 93 (86.1%) had normal pregnancy, 15 (13.9%) had miscarriage. Nine normal pregnancy outcomes with 3 miscarriages were in cases with Medical illness. Medical illness doesn't has correlation with pregnancy outcome (*Pearson Chi-Square test* p=0.306).

Menstrual cycle was regular in 106 cases and 14 had irregular cycles. Among 102 normal pregnancy outcome patients 92 (90.2% of normal outcome) had regular menstrual cycle, 10 (9.8% of normal outcome) had irregular periods. Among eighteen miscarriage cases 14 (77.8% of miscarriage) had regular menstrual cycle, 4 (22.2% of miscarriage) had irregular menstrual cycle. Menstrual cycle does not correlate with pregnancy outcome in our study (*Pearson Chi-Square test* p=0.13).

The Gestational sac size ranges between 12 and 67 mm with a mean of 32.12 mm. Among the normal pregnancy cases gestational sac size had a mean of 33.10 mm in the first trimester. But in the miscarriage group Gestational sac had a mean of 26.61 mm. Gestational sac had highly significant correlation with the first trimester pregnancy outcome (*T-test* p=0.007**).

The Yolk sac size varied between 2.5 to 7.0 with a mean of 4.892 mm. The Yolk sac size has significant correlation with the first trimester pregnancy outcome. (*T-test* p=0.002**). The heart rate of the fetus ranged between 100 and 180, with a mean of 154.62. The heart rate of the fetus predicted the first trimester pregnancy outcome significantly (*T-test* p=0.048*).

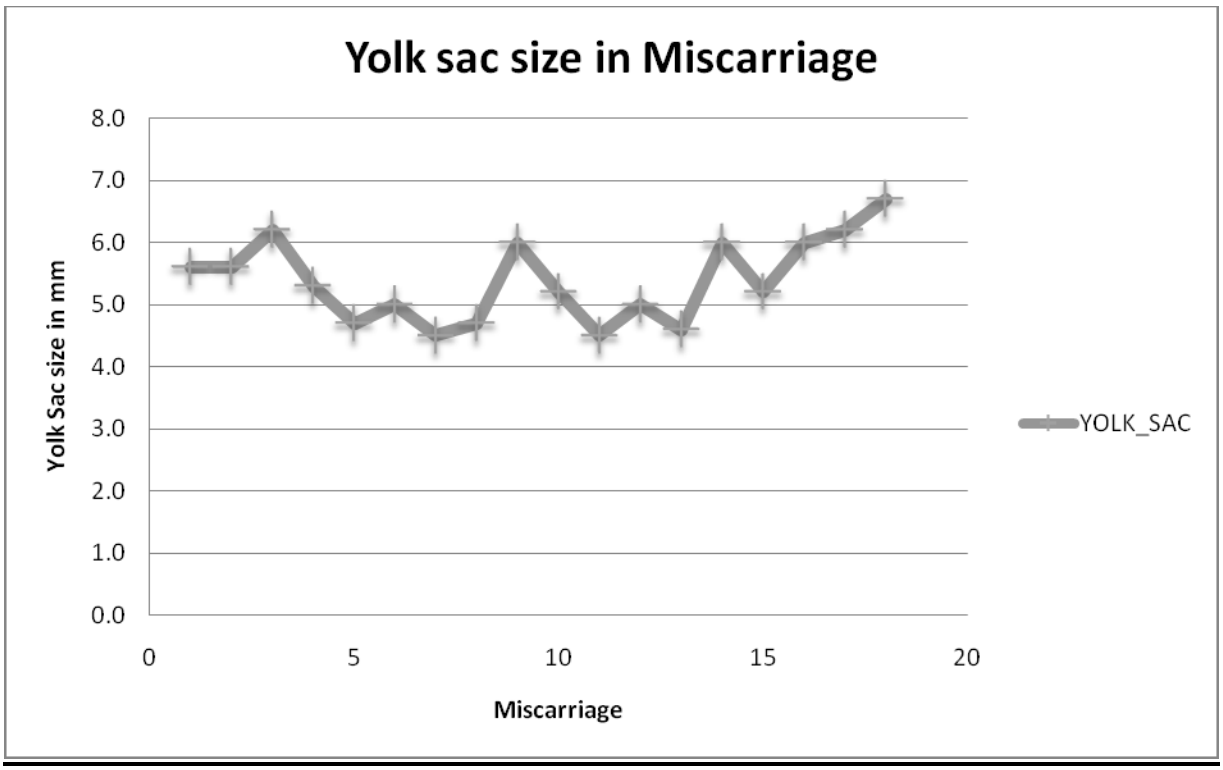
The gestational Age at the time of first scan predicted very significantly the first trimester pregnancy outcome (*T-test* p<0.001**) Gestational age ranged between 6.0 to 11.5 weeks with a mean of 8.426 weeks. The Crown Rump Length (CRL) was ranged between 10 and 58 mm with a mean of 24.51 mm. The CRL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

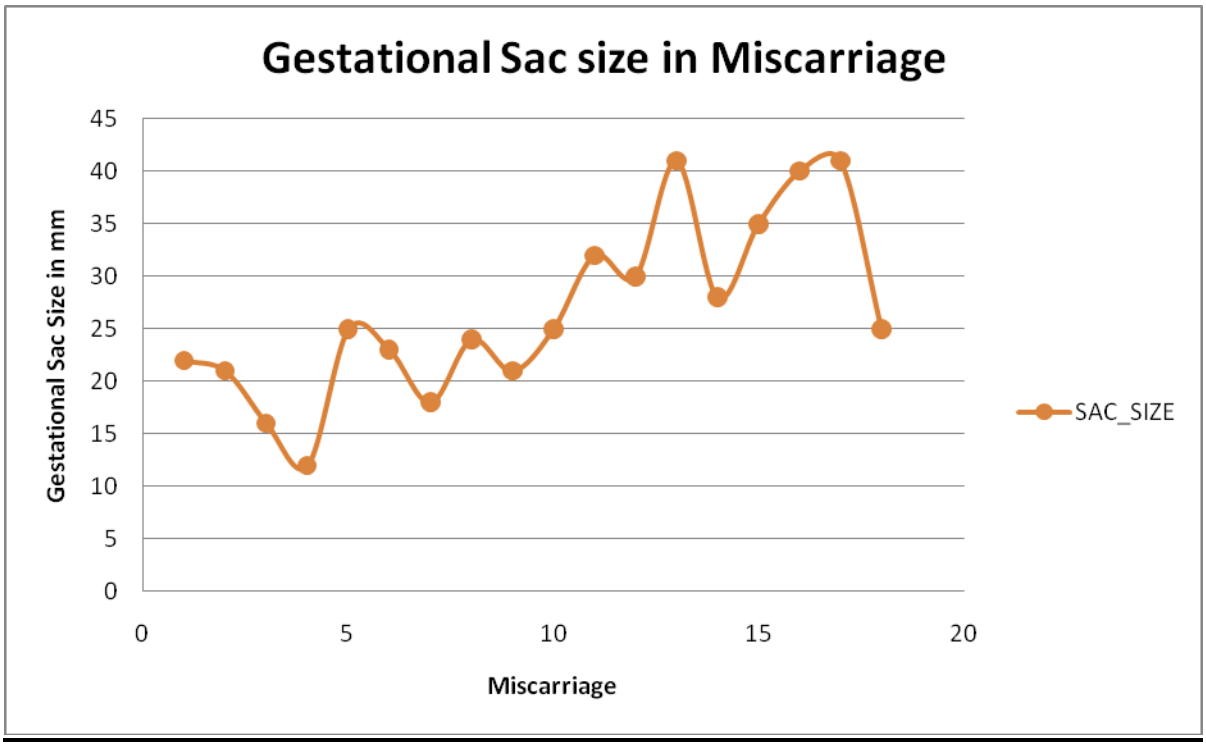
Table 1a: Descriptive data of all cases (n=120):

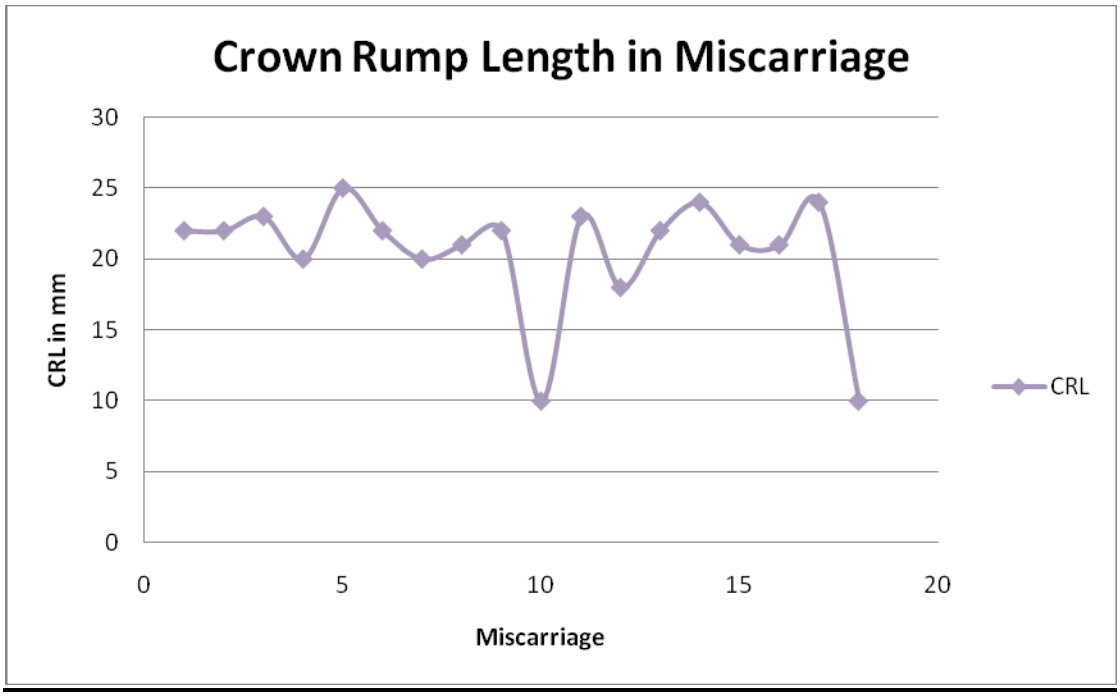
Data	Minimum	Maximum	Mean
Age (years)	16	36	23.73
Married since (years)	0.3	7.0	2.062
Gestational Sac Size (mm)	12	67	32.12
Yolk sac size (mm)	2.5	7.0	4.892
Heart Rate (Bpm)	100	180	154.62
Gestational Age (weeks)	6.0	11.5	8.426
Crown Rump Length (mm)	10	58	24.51

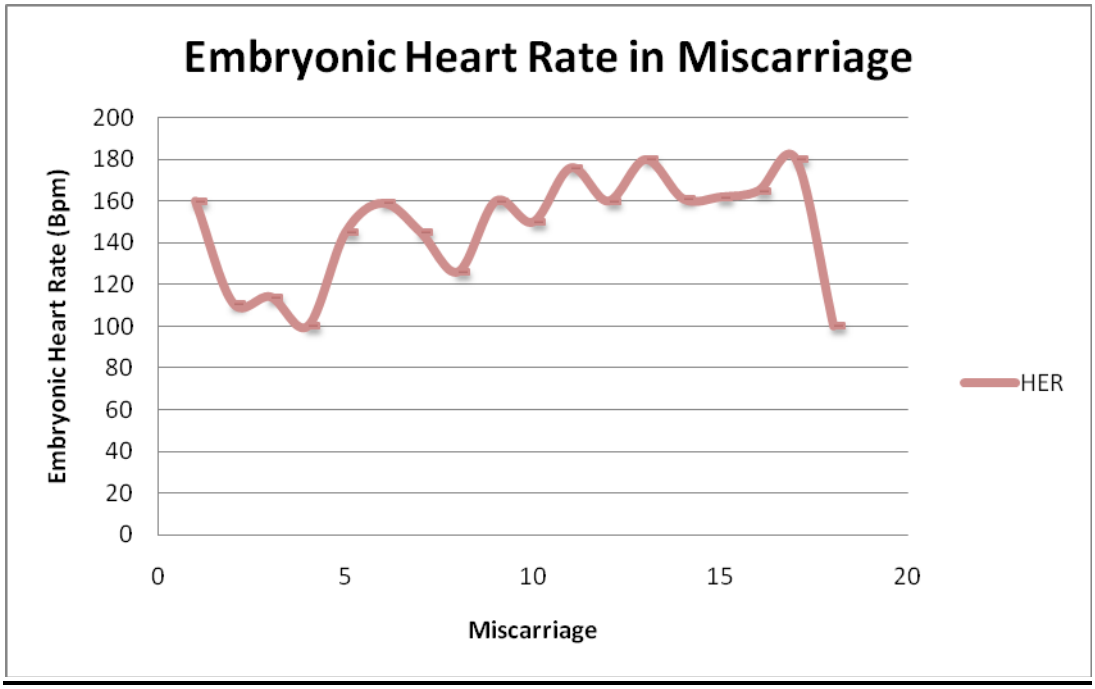
Table 1b: Descriptive data of Miscarriage subset (n=18):

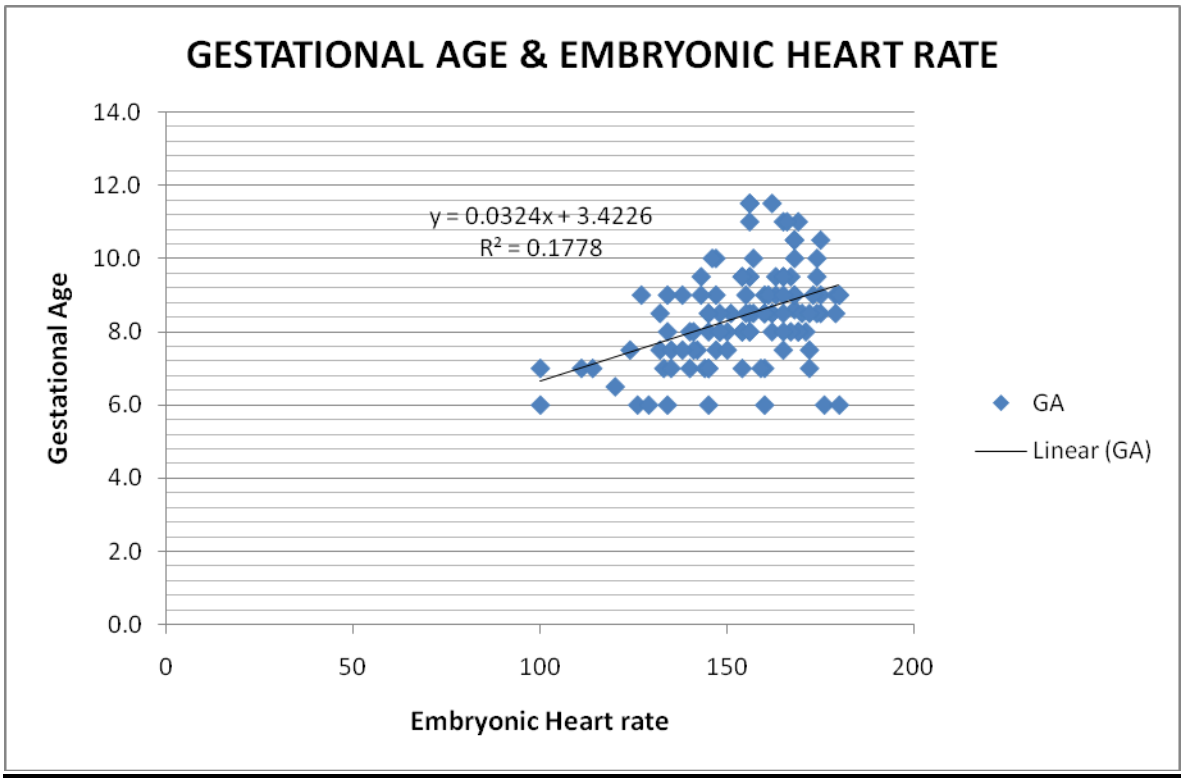
		Gestational Sac Size (mm)	Yolk sac size (mm)	Heart Rate (Bpm)	Gestational Age (weeks)	Crown Rump Length (mm)
Minimum		12	4.5	100	6.0	10
Maximum		41	6.7	180	9.5	25
Percentiles	25	21	4.7	123.00	6.0	20
	50	25	5.25	159.50	7.0	22
	75	32.75	6.0	162.75	8.5	23


Yolk sac size in Miscarriage
Yolk Sac size in mm
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
5
10
15
20
Miscarriage
YOLK_SAC


Gestational Sac size in Miscarriage
Gestational Sac Size in mm
45
40
35
30
25
20
15
10
5
0
0
5
10
15
20
Miscarriage
SAC_SIZE


Crown Rump Length in Miscarriage
CRL in mm
30
25
20
15
10
5
0
0
5
10
15
20
Miscarriage
CRL


Embryonic Heart Rate in Miscarriage
Embryonic Heart Rate (Bpm)
200
180
160
140
120
100
80
60
40
20
0
0
5
10
15
20
Miscarriage
HER


GESTATIONAL AGE & EMBRYONIC HEART RATE
y = 0.0324x + 3.4226
R² = 0.1778
Gestational Age
Embryonic Heart rate
GA
Linear (GA)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
50
100
150
200

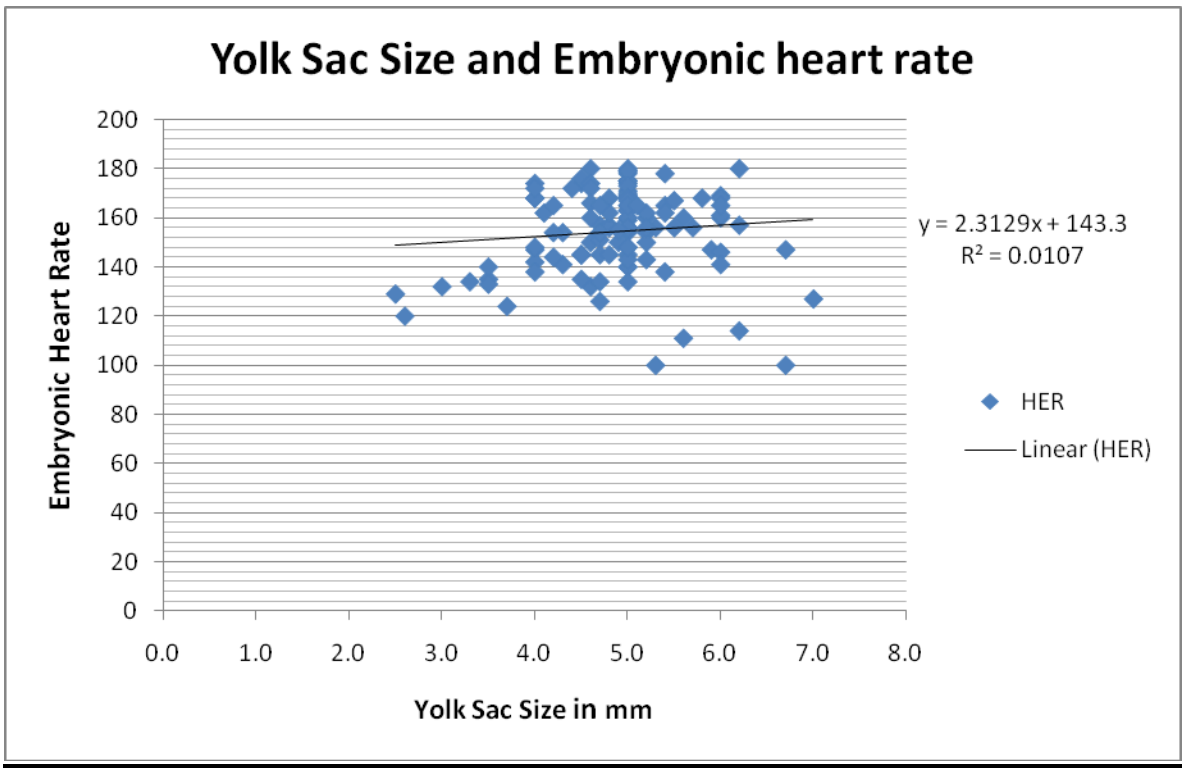

Yolk Sac Size and Embryonic heart rate
y = 2.3129x + 143.3
R² = 0.0107
Embryonic Heart Rate
Yolk Sac Size in mm
HER
Linear (HER)
200
180
160
140
120
100
80
60
40
20
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

Table 2: Marital status and Pregnancy outcome

			Pregnancy outcome		
			Normal	Miscarriage	Total
Marital status	Non-consanguinous	Count	89	11	100
		% within Marital status	89.0%	11.0%	100.0%
		% within Pregnancy outcome	87.3%	61.1%	83.3%
	Consanguinous	Count	13	7	20
		% within Marital status	65.0%	35.0%	100.0%
		% within Pregnancy outcome	12.7%	38.9%	16.7%
Total		Count	102	18	120
		% within Marital status	85.0%	15.0%	100.0%
		% within Pregnancy outcome	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.529(b)	1	**0.006****		
Continuity Correction(a)	5.765	1	0.016		
Likelihood Ratio	6.249	1	0.012		
Fisher's Exact Test				0.012	0.012
Linear-by-Linear Association	7.467	1	0.006		
N of Valid Cases	120				

a Computed only for a 2x2 table

b 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.00.

Table 3: Menstrual cycle and Pregnancy outcome

			Pregnancy outcome		
			Normal	Miscarriage	Total
Menstrual cycle	Regular	Count	92	14	106
		% within Menstrual cycle	86.8%	13.2%	100.0%
		% within Pregnancy Outcome	90.2%	77.8%	88.3%
	Irregular	Count	10	4	14
		% within Menstrual cycle	71.4%	28.6%	100.0%
		% within Pregnancy cycle	9.8%	22.2%	11.7%
Total		Count	102	18	120
		% within Menstrual cycle	85.0%	15.0%	100.0%
		% within Pregnancy cycle	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.290(b)	1	0.130		
Continuity Correction(a)	1.243	1	0.265		
Likelihood Ratio	1.952	1	0.162		
Fisher's Exact Test				0.223	0.134
Linear-by-Linear Association	2.270	1	0.132		
N of Valid Cases	120				

a Computed only for a 2x2 table
b 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.10.

Table 4: Parity and Pregnancy outcome

Parity		Pregnancy Outcome		Total
		Normal	Miscarriage	
Primi	Count	75	9	84
	% within Parity	89.3%	10.7%	100.0%
	% within Pregnancy Outcome	73.5%	50.0%	70.0%
G1P0A1L0	Count	4	0	4
	% within Parity	100.0%	0%	100.0%
	% within Pregnancy Outcome	3.9%	0%	3.3%
G2P1A0L1	Count	11	2	13
	% within Parity	84.6%	15.4%	100.0%
	% within Pregnancy Outcome	10.8%	11.1%	10.8%
G2P0L0A1	Count	5	3	8
	% within Parity	62.5%	37.5%	100.0%
	% within Pregnancy Outcome	4.9%	16.7%	6.7%
G2P1L0A1	Count	1	2	3
	% within Parity	33.3%	66.7%	100.0%
	% within Pregnancy Outcome	1.0%	11.1%	2.5%
G3P1L1A1	Count	3	0	3
	% within Parity	100.0%	0%	100.0%
	% within Pregnancy Outcome	2.9%	0%	2.5%
G3P0L0A2	Count	1	1	2
	% within Parity	50.0%	50.0%	100.0%
	% within Pregnancy Outcome	1.0%	5.6%	1.7%
G3P2L2A0	Count	1	1	2
	% within Parity	50.0%	50.0%	100.0%
	% within Pregnancy Outcome	1.0%	5.6%	1.7%
G4P1L1A2	Count	1	0	1
	% within Parity	100.0%	0%	100.0%
	% within Pregnancy Outcome	1.0%	0%	0.8%
Total	Count	102	18	120
	% within Parity	85.0%	15.0%	100.0%
	% within Pregnancy Outcome	100.0%	100.0%	100.0%

Chi Square Test

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.529(b)	1	**0.006****		
Continuity Correction(a)	5.765	1	0.016		
Likelihood Ratio	6.249	1	0.012		
Fisher's Exact Test				0.012	0.012
Linear-by-Linear Association	7.467	1	0.006		
N of Valid Cases	120				

a Computed only for a 2x2 table
b 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.00.

Table 5: Medical Illness and Pregnancy outcome

			Pregnancy outcome		
			Normal	Miscarriage	Total
Medical Illness	No	Count	93	15	108
		% within Medical Illness	86.1%	13.9%	100.0%
		% within Follow up	91.2%	83.3%	90.0%
	Yes	Count	9	3	12
		% within Medical Illness	75.0%	25.0%	100.0%
		% within Follow up	8.8%	16.7%	10.0%
Total		Count	102	18	120
		% within Medical Illness	85.0%	15.0%	100.0%
		% within Follow up	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.046(b)	0.306		
Continuity Correction(a)	0.356	0.551		
Likelihood Ratio	0.919	0.338		
Fisher's Exact Test			0.387	0.259
Linear-by-Linear Association	1.037	0.309		
N of Valid Cases	120			

a Computed only for a 2x2 table
b 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.80.

Table 6: Age and Pregnancy outcome:

T-Test **Group Statistics**

	Pregnancy outcome	N	Mean	Std. Deviation	Std. Error Mean
Age in years	Normal	102	23.41	3.697	0.366
	Miscarriage	18	25.50	3.451	0.813

Independent Samples Test

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

Table 7: Number of years since married and Pregnancy outcome:

T-Test **Group Statistics**

	Pregnancy outcome	N	Mean	Std. Deviation	Std. Error Mean
No. of years married	Normal	102	1.911	1.7105	0.1694
	Miscarriage	18	2.917	1.8570	0.4377

Independent Samples Test

	t-test for Equality of Means					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
No. of years married	-2.271	118	**0.025***	-1.006	-1.8829	-.1288
	-2.143	22.387	0.043	-1.006	-1.9782	-.0335

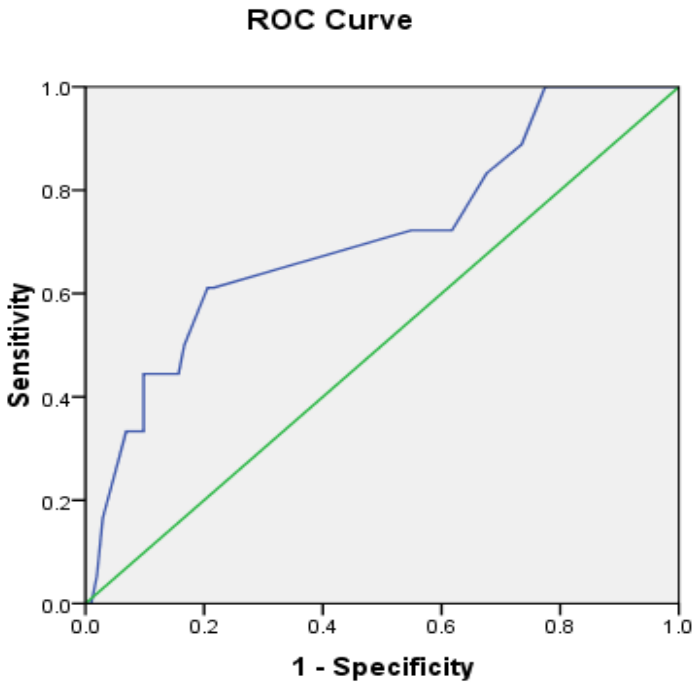
Table 8: Yolk sac Size and Pregnancy outcome:

T-Test **Group Statistics**

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

Independent Samples Test

	t-test for Equality of Means					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Yolk sac (mm)	-3.165	118	**0.002****	-0.585	-0.9509	-0.2190
	-3.341	24.541	0.003	-0.585	-0.9459	-0.2241



Diagonal segments are produced by ties.

Area Under the Curve

Test Result Variable(s):Yolk sac (mm)

Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
0.710	0.070	**0.005***	0.573	0.847

The test result variable(s): Yolk sac (mm) has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5

Table 9: Embryonic heart rate and pregnancy outcome:

T-Test **Group Statistics**

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

Independent Samples Test

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

Table 10: Gestational Age and Pregnancy Outcome:

T-Test **Group Statistics**

	Pregnancy Outcome	N	Mean	Std. Deviation	Std. Error Mean
Gestational Age (weeks)	Normal	102	8.638	1.1649	0.1153
	Miscarriage	18	7.222	1.1909	0.2807

Independent Samples Test

	t-test for Equality of Means					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Gestational Age (weeks)	4.739	118	**0.000****	1.416	.8243	2.0077
	4.666	23.115	0.000	1.416	.7884	2.0436

Table 11: Crown Rump Length and Pregnancy Outcome:

T-Test **Group Statistics**

	Pregnancy Outcome	N	Mean	Std. Deviation	Std. Error Mean
Crown Rump Length (mm)	Normal	102	25.21	9.508	0.941
	Miscarriage	18	20.56	4.176	0.984

Independent Samples Test

	t-test for Equality of Means					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Crown Rump Length (mm)	2.035	118	**0.044***	4.65	0.125	9.175
	3.414	54.637	0.001	4.65	1.920	7.380

Table 12: Gestational Sac Size and Pregnancy Outcome

T-Test **Group Statistics**

	Pregnancy Outcome	N	Mean	Std. Deviation	Std. Error Mean
Gestational Sac size (mm)	Normal	102	33.10	9.330	0.924
	Miscarriage	18	26.61	8.465	1.995

Independent Samples Test

	t-test for Equality of Means					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
SAC size (cms)	2.755	118	**0.007****	6.49	1.824	11.150
	2.950	24.876	0.007	6.49	1.957	11.017

Table 13a: Correlation of Pregnancy outcome with all other parameters (AFTER EXCLUDING THE CASES WITH UNKNOWN 'LMP') (n=108) One Way ANOVA with Post HOC Turkey test

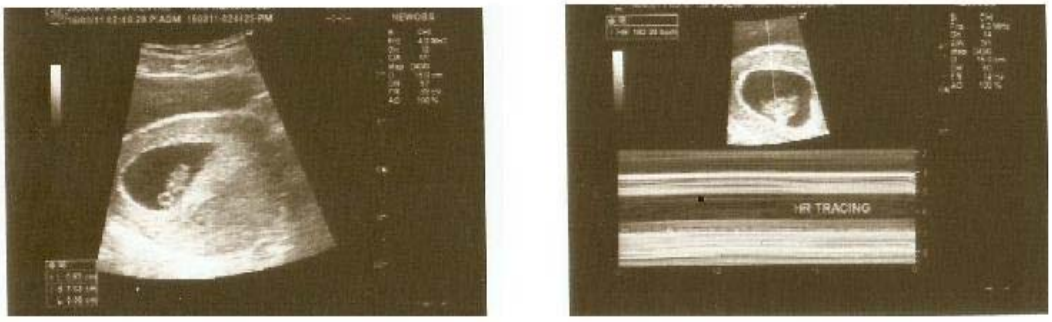
ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
AGE	Between Groups	46.357	1	46.357	3.752	**0.055***
	Within Groups	1309.523	106	12.354		
	Total	1355.880	107			
PARITY	Between Groups	13.683	1	13.683	4.212	**0.043***
	Within Groups	344.317	106	3.248		
	Total	358.000	107			
Marital Status	Between Groups	.846	1	0.846	7.016	**0.009****
	Within Groups	12.783	106	0.121		
	Total	13.630	107			
Marital years	Between Groups	10.882	1	10.882	3.447	**0.066***
	Within Groups	334.641	106	3.157		
	Total	345.523	107			
Menstrual cycle	Between Groups	.252	1	0.252	4.236	**0.042***
	Within Groups	6.295	106	0.059		
	Total	6.546	107			
Weeks at which first scan taken	Between Groups	2.332	1	2.332	1.295	0.258
	Within Groups	187.209	104	1.800		
	Total	189.540	105			

Table 13b: Correlation of Pregnancy outcome with all other parameters (AFTER EXCLUDING THE CASES WITH UNKNOWN 'LMP') (n=108) One Way ANOVA with Post HOC Turkey test

ANOVA

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



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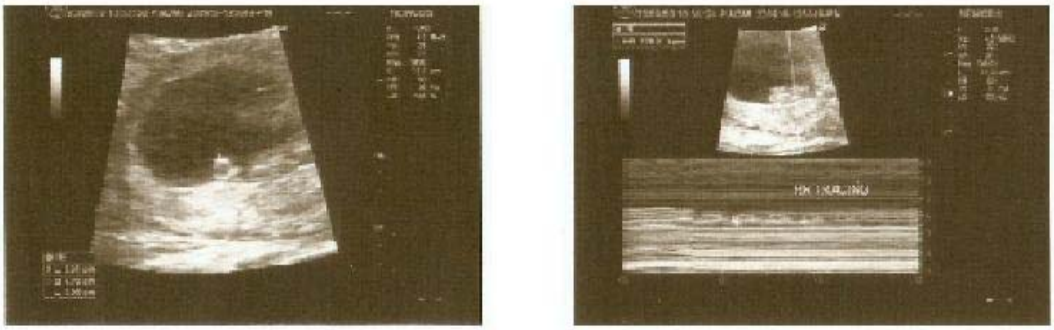

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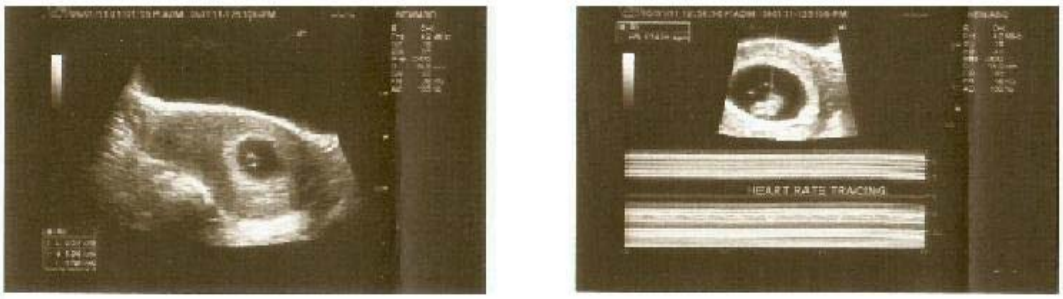

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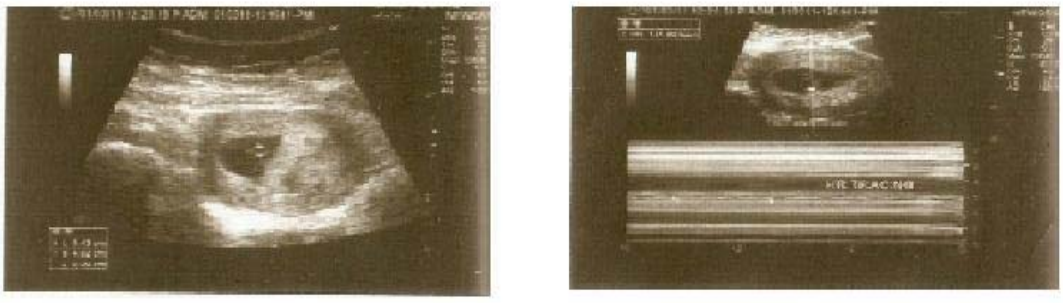

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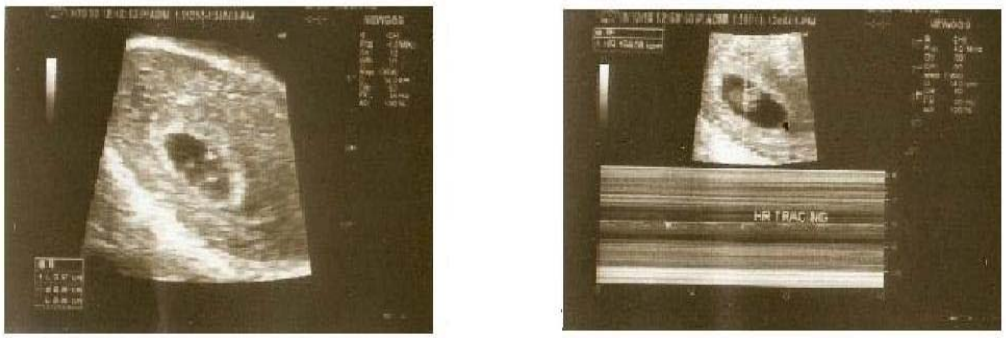

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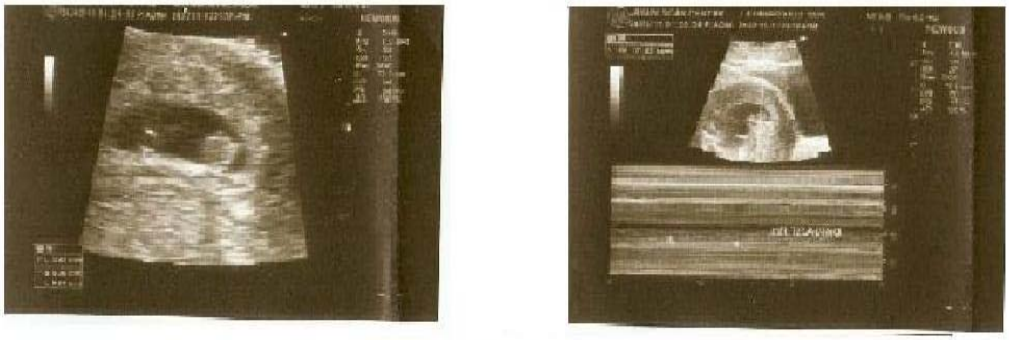

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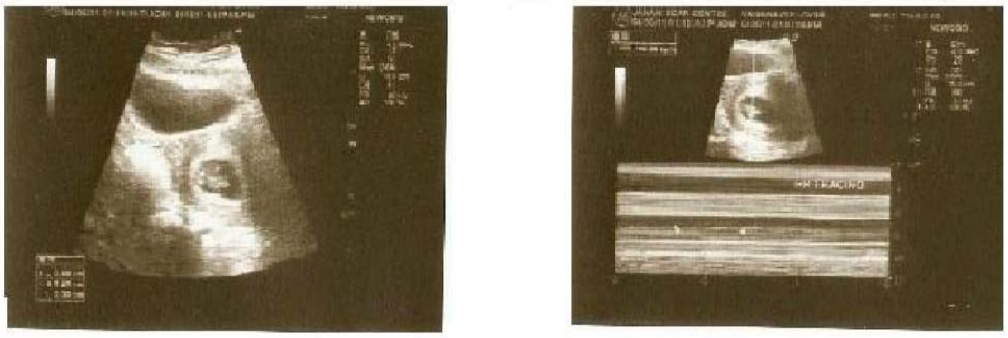

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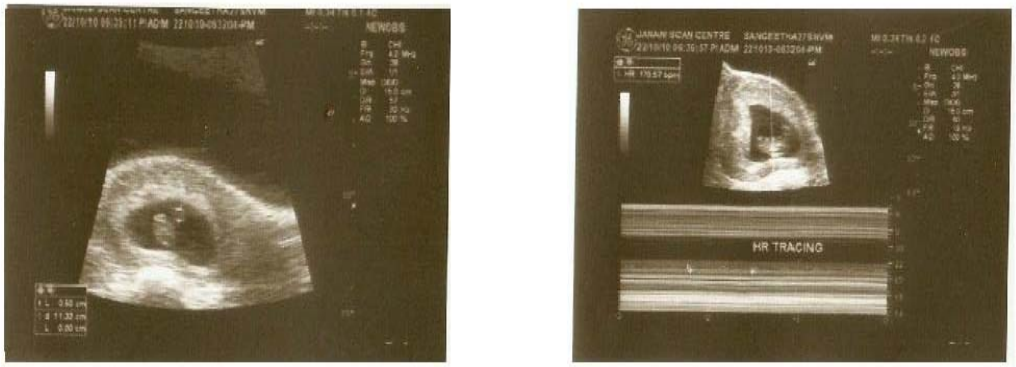

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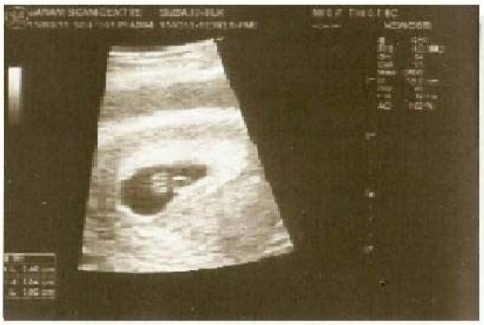
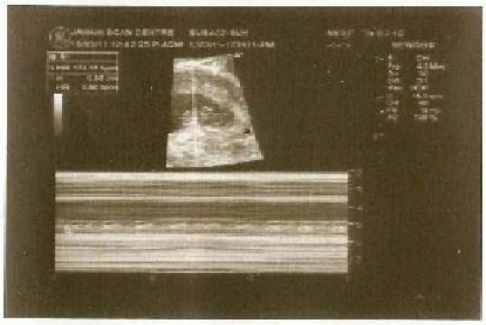

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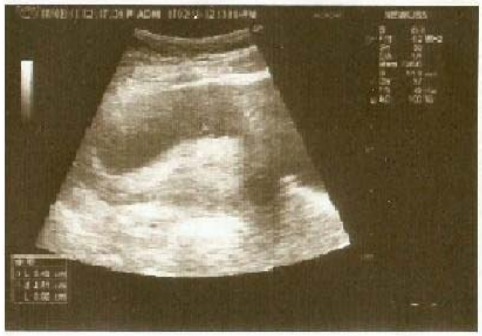
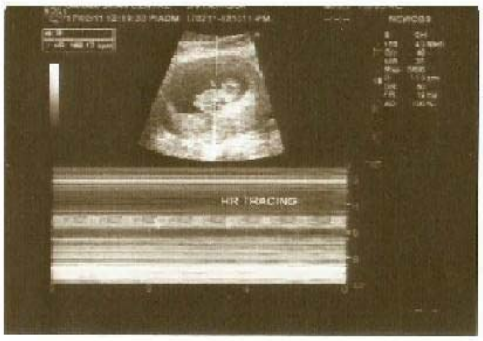

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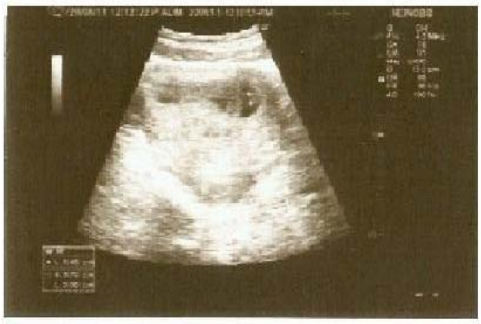
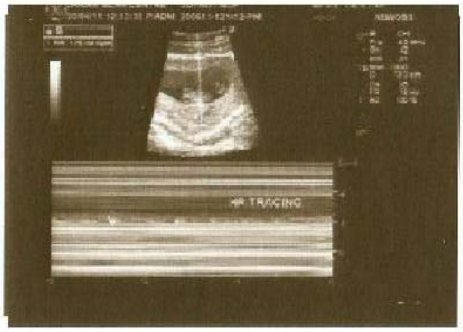

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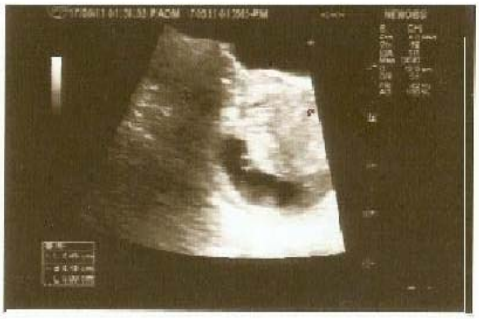
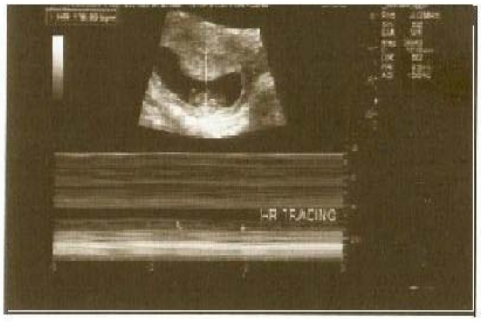

Picture No:12, Patient OP no 90186

Discussion

6.0. DISCUSSION

Miscarriage occurs in approximately 30–40% of implanted pregnancies, is the commonest complication of pregnancy [4]. Numerous studies have examined the potential value of demographic characteristics and various ultrasonographic parameters in the prediction of those pregnancies that will miscarry. These studies have reported an association between increased risk for miscarriage and advanced maternal age, previous history of miscarriage, vaginal bleeding, fetal bradycardia, early onset fetal growth restriction, small gestational sac volume and large yolk sac. However, most of these studies included small numbers of patients, were retrospective or were carried out in highly selected populations, including women presenting with vaginal bleeding or abdominal pain and in pregnancies achieved using assisted reproduction techniques [5]. In the light of these limitations, we did a prospective study in this topic.

In our prospective study 120 antenatal women were included belonging to first trimester, who were attendees of Govt. RSRM Lying-in Hospital attached to Stanley medical college, during December 2010 to November 2011. There was a linear correlation (p=0.028*) between the age at time of pregnancy and miscarriage. Our study supports the fact that as the maternal age increases, chances of spontaneous abortion also increases. Studies have also shown that the rate of

spontaneous abortion following cardiac activity is influenced by maternal age. So a cardiac activity is not necessarily a reassuring sign in the older patient [6].

Our study is in agreement with the fact that consanguinous marriage increases the adverse outcome. Consanguinous marriage is still prevalent in the population studied. *Chama et al* recommended that patients at risk of prior pregnancy outcome should have routine TVS before 12 weeks of pregnancy to assess the yolk sac and those with abnormal yolk sac should be followed to exclude fetal abnormalities before 24 weeks of gestation. Menstrual cycle irregularity was noted in 14 cases among them only 4 cases aborted, and menstrual cycle irregularity doesn't correlate with the first trimester outcome as such. But, after excluding the cases with unknown LMP, menstrual cycle correlates significantly (p=0.042*) with pregnancy outcome [Table 13a].

Previous abortions have significantly influenced the present pregnancy (p=0.006**). Among 20 cases with previous abortions, 6 of them aborted in the present pregnancy. According to *Soyoung Bae et al,* for women with a history of recurrent pregnancy loss, if embryonic cardiac activity, yolk sac and gestational sac markers were present, the rate of accurate positive (normal continuation) prediction was 94%. But any change in these parameters may affect current pregnancy as per our study. *Makrydimas et al* seem to agree with the negative

impact of advanced maternal age and history of miscarriages to subsequent pregnancy outcome [5].

In our study medical illness in the mother does not correlate with the pregnancy outcome (p=0.306). This is accordance with the previous studies. So the women with previous medical illness like systemic hypertension, PCOD, Diabetes Mellitus, Hypothyroidism may have good outcome of first trimester provided the fetal cardiac rate and Yolk sac size are within normal range.

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

predictor of first trimester outcome even though it had significant correlation in our study.

The increase in yolk sac diameter during the first trimester and its correlation with advancing gestational age lie in agreement with most of the previous studies [10], although some researchers support that the growth of yolk sac during the first trimester is not constant [11]. We demonstrated that the pregnancies with mean yolk sac diameter>or=5 mm on early ultrasound require monitoring and counseling. About a threefold increased risk for first-trimester loss independent of maternal risk factors such as age, body mass index, polycystic ovary syndrome, smoking, and diabetes and we agree with recent studies that support the negative predictive value of the absence of yolk sac [12] [13]. We studied only the yolk sac size and not its shape; therefore we cannot comment on previous articles that associate abnormal shapes of the yolk sac with poor pregnancy outcome [14]. In addition, enlarged yolk sac diameter may be associated with an increased risk of preterm delivery [15].

Embryonic heart rate has significant correlation with the first trimester outcome in our study (p=0.048*). FHR has been studied extensively and numerous studies have demonstrated a strong association between pathological FHR and fetal loss. Fetal bradycardia is a sign of impending fetal death reflecting the forthcoming collapse of the cardiovascular system. Another possible cause for the high

miscarriage rate in fetuses with abnormal FHR is that there may be an underlying chromosomal abnormality, such as trisomy 18 or triploidy, which is associated with fetal bradycardia [16]. But tachycardia is a feature of trisomy 21(Down Syndrome [17].

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

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

The routine use of TVS in the investigation and diagnosis of early pregnancy problems has also led to improvements in the management of early pregnancy loss. Improved access to early pregnancy units and increasing awareness amongst women of their choices in the management of early pregnancy problems has led to an increasing demand for more conservative management of early miscarriage. Up to 70% of women will choose expectant management of miscarriage if given the choice [21]. For these purposes the predictors of early fetal demise and monitoring the same is essential in the current practice.We did follow up scans for the patients who had abnormal ultrasonic markers. Twenty two cases have undergone follow up scan, among them only 6 had normal continuation of pregnancy, remaining 16 aborted ($p<0.001$**).

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

Summary & Conclusion

7.1 SUMMARY

In our prospective study of 120 patients there was a linear correlation between age at the time of pregnancy and miscarriage. As the maternal age increases, there is increased chance of spontaneous abortion.

Consanguinous marriage influences the pregnancy outcome. There is increased rate of abortion among consanguinous marriage compared to non-consanguinity.

In our study women with medical illness like systemic hypertension, diabetes mellitus, hypothyroidism also had a good outcome. Medical illness in the mother does not correlate with pregnancy outcome.

Patients with history of previous abortions are likely to have subsequent abortion in the following pregnancy.

Gestational sac size significantly correlates with the first trimester pregnancy outcome. A smaller than expected gestational sac can be a predictor of poor pregnancy outcome both alone or in combination with other parameters.

Yolk sac diameter in the first trimester significantly correlates with the pregnancy outcome. An enlarged yolk sac has increased risk of preterm delivery.

In our study embryonic heart rate influences the pregnancy outcome. Fetal bradycardia is a sign of impending fetal death mostly due to chromosomal abnormality trisomy 18 and triploidy. Tachycardia is a feature of trisomy 21.

7.2 CONCLUSION

The conclusion drawn from the present study are as follows

1. Maternal age correlates with the pregnancy outcome. As the maternal age increases the chances of miscarriage increases.
2. Miscarriages are more common among the patients with consanguinous marriage.
3. The pregnancy outcome is not influenced by the medical illness in the mother.
4. The gestational sac size significantly correlates with the first trimester pregnancy outcome.
5. Yolk sac diameter and embryonic heart rate in the first trimester significantly correlates with the first trimester pregnancy outcome.

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

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Annexure

PROFORMA

YOLK SAC MEASUREMENTS AND EMBRYONIC HEART RATE IN PREDICTING FIRST TRIMESTER PREGNANCY OUTCOME.

NAME : AGE: I.P. NO. :

SOCIAL STATUS : BOOKED/UNBOOKED:

LMP : G P L A

EDD : GESTATIONAL AGE :

DATE OF USG :

OBSTETRIC HISTORY :

MATERNAL ILLNESS :

GENERAL EXAMINATION :

HT. WT. PULSE: BP: TEMP:

ANAEMIA: EDEMA: CVS: RS:

OBETETRIC EXAMINATION

P/A :

USG

GESTATIONAL SAC SIZE: EMBRYONIC HEART RATE:

YOLK SAC SIZE : GESTATIONAL AGE:

KEY TO MASTER CHART

P-parity

1 –primi
2 –G2A1
3 –G2P1L1
4 –G3P1L0A1
5 –G2P1L0A1
6 –G3P1L1A1
7 –G3A2
8 –G3P2L2
9 –G4P1L1A2

LMP-last menstrual period

GS -gestational sac
YS - yolk sac
HR -heart rate
GA - gestational age
CRL- crown rump length

FU -follow up
0 -normal
1 -miscarriage

MS- marital status

0 -non-consanguinous marriage
1 –consanguinous marriage

MC- menstrual cycle

0 -regular
1 –irregular

MI-medical illness

0 -no
1 -yes