Early First Trimester Growth Restriction

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ABSTRACT:

The miscarriage of an early pregnancy is amongst one of the most prevalent medical complications in humans. It has been observed that approximately 50% of conceptions eventually have an adverse pregnancy outcome at the end of first trimester. Most miscarriages occur within the first month after the preceding menstrual period, so that the patient is often unaware of both the conception and the subsequent abortions. Pregnancies which had significantly small CRL than expected later on had higher chances of ending up in miscarriage.

Fetal growth restriction (FRG) is a condition where fetus fails to attain its normal growth potential. The study aims to evaluate the prognosis of pregnancies which have early first trimester fetal growth restriction. The routine usage of TVS ultrasound in investigating and diagnosing the early pregnancy problems has led to essential improvements in management of the early pregnancy losses and the patient's perception of the normal and abnormal fetal development in utero.

The ability to make an accurate risk estimation of the prediction of subsequent pregnancy failure is important not only for the counseling of the individual prospective parents and but also from the broader public health problems in a perspective manner.

Keywords: Miscarriage, first trimester ,adverse pregnancy outcome, Fetal growth restriction, TVS ultrasound

INTRODUCTION:

Fetal growth restriction (FRG) can be described as a condition where fetus fails to attain its genetically set on growth potential. Restricted fetal growth is a major pregnancy complication and it also determines prenatal morbidity and mortality. Increasing evidence suggests that Fetal growth restriction (FGR) might have origins in early pregnancy. Early onset FGR has a strong association with adverse neonatal outcomes, while late-onset FGR presents with subtle biophysical abnormalities and is therefore more difficult to diagnose[1].

Early recognition of fetuses at risk of Fetal growth restriction (FGR) enables more appropriate surveillance and management, which has been shown to reduce risks of adverse fetal outcomes. To study early fetal growth restriction, it is preferable to use ultrasonographic imaging with estimation of change over specific time intervals as it has the ability to diagnose early pregnancy growth restriction and related conditions. Serologic markers are not specific and show signs only after loss of pregnancy were diagnosed[2].

Trans vaginal ultrasound (TVUS) is by and large used to make diagnosis of intrauterine pregnancy and developmental follow-up due to its capability to produce high-resolution images, low inter-observer variability with high reliability. Parameters like Crown-rump length (CRL), Gestational sac diameter (GS), fetal heart rate (HR) and yolk sac (YS) are measured to diagnose early pregnancy. Any deviations in the parameters shown above during ultrasound are further investigated to predict any possibility of first trimester pregnancy loss[1,2, 3].

Ultrasound findings associated with subsequent miscarriage include a slow embryonic heart rate (HR), less than normal gestational sac diameter (GS) and abnormal yolk sac diameter. Smaller Crown-rump length (CRL) findings have also been associated with subsequent adverse pregnancy outcomes. Chromosomal defects not only have a high intrauterine lethality rate but can also be associated with fetal growth restriction like smaller Crown-rump length (CRL) in the first trimester of pregnancy which further leads to miscarriage.[3] The miscarriage of an early pregnancy is amongst one of the most prevalent medical complications in humans. It has been observed that approximately 50% of conceptions eventually at the end of first trimester have a bad outcome. Most miscarriages occur within the first month after the preceding menstrual period, so that the patient is often unaware of both the conception and the subsequent abortions. Former studies have reported pregnancies which had significantly small CRL than expected later on had higher chances of ending up in miscarriage[2, 3]

ETIOLOGY:

The etiology can be clinically divided into three factors clinically that is, fetal factor, maternal factor and placental factor. Howsoever, overlapping has been seen in all three pathogenesis[7].

Fetal factor: Genetic abnormalities in fetus have been seen in 5% percent to 20% percent of cases of fetal growth restriction. Most commonly aneuploidy is the cause for fetal growth restriction before 20 weeks. Fetal infection is cause in 5%-10%, cytomegalovirus and toxoplasmosis being the most common. Other causes may be non chromosomal congenital anomalies or other specific syndromes.

Maternal causes: Maternal disorders can interfere with utero placental –fetal blood flow. These conditions are chronic hypertensive disease, gestational diabetes mellitus or pre gestational diabetes mellitus, autoimmune disease, severe cardiopulmonary or renal diseases,

sickle cell disease, severe anemia and malnourishment, substance abuse like excessive use of alcohol, addiction to recreational drugs like cocaine, nicotine, heroin, marijuana, etc, anti-neoplastic drugs or exposure to radiation, chronic ante partum hemorrhage. If pregnant mother is herself malnourished and is with restricted growth then there is twice as much risk of giving birth to fetal growth restricted fetus. Mother's nutritional status is also responsible for development of fetus, which may end up being 10% of FGR fetus[8,9].

Placental cause: Chromosomal placental mosaicism (CPM), presenting with placental trisomy and a chromosomally well developed fetus, is identified in 33% of FGR with placental infarction, decidual vasculopathy and 10% of idiopathic cases of FGR. Placental abnormalities like bilobate or circumvallate placenta, small sized placenta, any placental mesenchymal dysplasia, anomalies related to umbilical cord like single artery, velamentous or marginal cord insertion are some of the other causes of fetal growth restriction. History of any maternal morbidity has negative impact on the fetal growth via affecting its placental functions[8,9].

THE EARLY FIRST TRIMESTER SCAN:

The earliest sign of pregnancy is persistence of vascularised corpus luteum beyond day 28. This appears as a cystic, hyper echoic, isoechoic or echogenic area in active ovary and intense peripheral blood flow signals on color flow mapping. Implantation commences on day 19 of the cycle and is completed by day 23. Conceptus at this stage is 0.1mm in length but cannot be seen with currently available ultrasound equipment. Gestational sac diameter gets visualized between 4 weeks plus 1 day to 4 weeks plus 3 day by TVS scan. Gestational sac perhaps could be demonstrated at as early as beta HCG of 300 MIU/ml but it is evident by discriminatory level of 1000 MIU/ml. Failure to demonstrate gestational sac at this level might indicate failed intrauterine pregnancy or ectopic pregnancy. Gestational sac may be round or oval and the calculation of its quantification is done by mean sac diameter. Gestational sacs are first seen when they reach a size of 2-3 mm. As MSD reaches to 10mm, a double decidual sign appears. First structure to appear within GS is yolk sac; with TVS yolk sac can be first visualized by MSD 5 mm and evident by MSD 8 mm. The maximum diameter of a healthy yolk sac is 5-6 mm, which can be used to calculate gestational age. Irregular or abnormal yolk sac size or morphology needs serial evaluation to follow the outcome[8].

Embryonic cardiac activity appears at 34 days of gestational age, embryo length is 1.6 mm, embryonic heart rate is about 100-115 bpm and slowly progresses to 144-159 bpm by week 8. From week 8-10, the embryo and amniotic membrane growth takes place at a pace of 1 mm per day. Fetal length at this stage is equal to amniotic sac diameter. 12 mm of embryonic length corresponds to 12 mm of MSD. The brain and trunk start to become distant by 8-9 weeks of gestation. Embryonic movements become apparent at the ending of the 8 weeks of gestation. Developing embryos can be measured end to end to assess the gestational age, this

is known as crown rump length. The distance from top of head to bottom of rump of embryo in neutral posture and there should not be any flexion or extension. Three readings are taken then their mean is calculated. This is used to calculate the gestational age from 5 weeks 3 days till 13 weeks 6 days. In pregnancy this is the most trusted parameter to measure gestational age. Ultrasound is the well founded tool to evaluate early complications in pregnancy[7, 8, 9].

Criteria for failure of pregnancy include embryos without pulse which are 7 mm or more in CRL or a gestational sac diameter of larger than 25 mm with no embryo. Prognosis is poor if we find embryonic bradycardia suboptimal embryonic growth and unusually large or small gestational sac, an abnormal yolk sac, a hemorrhagic chorionic sac or amniotic cavity same as diffuse or focal variability echoic specks and a thin trophoblast, chorio residual and amnio residual separation are seen in pregnancy with pain or bleeding but at times also asymptomatic. So objective evaluation is done which includes volume assessment and assessment of the sac perimeter. It is important for serial comparison.

ASSESSMENT OF GESTATIONAL AGE:

To assess growth restriction, it is important to have a proper evaluation of gestational age. Crown rump length measurements between ages 8 to 14 weeks provide the most accurate assessment of fetal age. This equals the accuracy of assessment of ovulation studies[1] and embryo transfer calculations[8,9]. Mean gestational sac diameter which is measured before embryo is visualized has accuracy of $\pm 5 \, days$.

Finding	Diagnostic of pregnancy failure	Suspicious for pregnancy failure
Absent fetal cardiac activity by the time CRL is a certain size	CRL ≥7 mm	CRL <7 mm
Absent embryo by the time the gestational sac is a certain size	MSD ≥25 mm	MSD 16-24 mm
Absent embryo in two consecutive exams separated by time	Nonvisualization of an embryo with fetal heart rate 2 wk after identification of gestational sac without yolk sac	Nonvisualization of an embryo with fetal heart rate 7-10 days after US showed gestational sac with yolk sac
	Nonvisualization of an embryo with fetal heart rate 11 or more days after identification of a gestational sac with yolk sac	Nonvisualization of embryo 6 wk after LMP

Finding	Diagnostic of pregnancy failure	Suspicious for pregnancy failure
Abnormal morphology of the gestational sac, amnion, and yolk sac	-	Amnion seen adjacent to yolk sac with no visible embryo (empty amnion)
	-	Yolk sac >7 mm
	-	Disproportionately small gestational sac (in relation to size of embryo, <5 mm difference in size between MSD and CRL)

Ultrasound waves are the result of an inverse piezoelectric effect. The piezoelectric effect refers to the phenomenon that takes place when pressure is applied to the surface of certain crystals. Inversely, an electric pulse when applied to piezoelectric materials; mechanical pressure produces electric current and that mechanical wave is an ultrasound beam. Many piezoelectric crystals mount together in an ultrasound transducer. After an electric pulse passes it, ultrasound waves are generated, which through the transducer goes into tissue in their path. These waves make a tissue interface, they are reflected back to the transducer and converted to an electric signal, which processes and displays an ultrasound image. Obstetric ultrasound employs a frequency of 1-15 megahertz. Abdominal transducers use a frequency of 1-9 MHz and the transvaginal transducers use frequencies of 5-15 MHz Transvaginal scanning is used in the early first trimester for accurate information regarding early pregnancy complications and fetal morphology. Information may be displayed as a sagittal, coronal, axial or oblique section. There is A mode, B mode and M mode, The B mode studies in motion mode is known as M mode. This is currently employed in obstetrics to evaluate fetal cardiac motion to estimate fetal heart rate and fetal cardiac rhythm as well as to study excursions of cardiac valves and myocardium. There are some considerations before an ultrasound examination. Patients should be treated with respect, care and reassurance about the painlessness and safety of examination.

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