ORIGINAL ARTICLE

# Utility of First Trimester Anomaly Scan in Screening of Congenital Abnormalities in Low and High Risk Pregnancies

**Neeta Natu, Nitin Wadnere*, Summi Yadav, Ravindra Kumar****

**Abstract**

The primary objective of the present study is to assess the feasibility and value of first trimester anomaly scan in both high risk and low risk pregnant patients. All high risk and low risk patients with live fetus and 11- to 14-week gestation were enrolled in study after informed and written consent. All patients were screened for congenital anomalies by 11-14 week ultrasound scan (first trimester anomaly scan) as part of routine prenatal care. Second trimester scan was conducted at 18 to 22 weeks gestation. The results of the first trimester anatomic survey were correlated with second trimester target scan to evaluate value of first trimester scan for early detection of anomalies. Overall prevalence of congenital anomalies in study population was 2.6%. Out of these 64.4% were detected by first trimester anomaly scan, while another 35.6% were detected by mid gestation scan. Detailed first trimester anomaly scan and first trimester fetal echocardiography should be performed to detect the fetal anomalies early.

**Key Words**

First Trimester Anomaly Scan, Low Risk Pregnancy, High Risk Pregnancy

## Introduction

Ultrasound is the main screening and diagnostic tool for congenital structural abnormalities. The early pregnancy (first trimester) scan was initially introduced with the primary intention of measuring the fetal crown-rump length to achieve accurate pregnancy dating. With growing experience of sonographers and improving equipment, detailed depiction of fetal structures including the fetal heart became possible. With improvement in the resolution of ultrasound machines and wide application of the nuchal translucency (NT) scan, it is possible to delineate normal fetal anatomy and diagnose a wide range of fetal abnormalities in the first trimester. (1) Measurement of NT thickness between 11 and 14 weeks gestation, combined with maternal age and maternal serum biochemistry, can be an effective method of screening for trisomy 21 and other chromosomal abnormalities. Besides nuchal abnormalities, a wide range of other congenital anomalies can be diagnosed with ultrasound at 11-14 weeks gestation, including defects of the central nervous system, heart, anterior abdominal wall, urinary tract, and skeleton. (2) Early (11-14 weeks) sonography for the detection of fetal malformations has been the subject of intensive investigation in recent years. (3) With the growing success in identifying fetal anatomic structures and structural anomalies in the first trimester, several studies have assessed the ability of first trimester ultrasonography to detect fetal structural malformations. These pilot studies have reported detection rates comparable with those achieved in the routine second-trimester anatomic survey at 18 to 22 weeks of gestation.

**From the Deptt. of Obst & Gynecology & *Radidiagnosis, Sri Aurobindo Institute of Medical Sciences & **Central Research Laboratory, Sri Aurobindo Institute of Medical Sciences, Indore, Madhya Pradesh, India**

**Correspondence to :** Dr Neeta Natu Associate Professor, Deptt. of Obst & Gynecology Sri Aurobindo Institute of Medical Sciences, Indore Ujjian State Highway, Indore, Madhya Pradesh, India. 453111

(4) However, there is no reliable data on early (11-14 week) congenital anomaly scan in Indian patients. Besides, most of the studies have focused on high risk population. Hence, present study was planned to look for feasibility of first trimester ultrasound scan for congenital anomalies in Indian patients in both high risk and low risk pregnancy.

Thus aim of this study was to assess the feasibility and value of first trimester anomaly scan in both high risk and low risk pregnant patients.

**Material and Methods**

This was a prospective observational study conducted during Dec 2011- Oct 2013 with institutional ethics committee approval. Women visiting to the antenatal clinic of Sri Aurobindo Institute of Medical Sciences, Indore were enrolled in the study after taking informed consent. Women with absent cardiac activity, molar pregnancy, ectopic pregnancy, and late booking (over 14 week's gestation) were excluded from the study. Patients were divided into two groups based on risk associated with pregnancy

High risk pregnancy was defined as any one of the following risk factors

1. Advanced maternal age (>30 years)
2. Previous history of any congenital anomaly or pregnancy loss
3. Family history of structural defects
4. Pregnancy after assisted reproductive techniques
5. Maternal diseases like Diabetes mellitus or Epilepsy
6. Multiple pregnancy
7. History of smoking or alcohol consumption in antenatal period
8. Previous affected child with chromosomal aberration

Low risk pregnancy was defined as a young women <30 years of age and not having the above mentioned risk factors.

*Methodology:* Women and their partners received group and/or individual counseling about prenatal screening and diagnosis of congenital anomalies. Demographic profile of all enrolled patients including age of mother, detailed obstetric history (gravida, parity, live issues and abortions), previous and family history of congenital anomalies, history of smoking or alcohol consumption in mother, and any prolonged illness in mother (diabetes mellitus, jaundice, hypertension, epilepsy etc.) were recorded in a predesigned proforma. Mode of conception (spontaneous or assisted) and associated obstetric complications were also noted in the proforma.

All patients were screened for congenital anomalies by 11-14 week ultrasound scan (first trimester anomaly scan) as part of routine prenatal care. First trimester anomaly scan (FTAS) was done by Voluson E8 Expert ultrasound machine (GE healthcare, India). The scan included demonstration of number and location of fetus (intrauterine/ectopic), spontaneous fetal, movements and various fetal organs. Fetal growth parameters including biparietal diameter, crown-rump length, head and abdominal circumference and femur length were measured for gestational age calculation. Nuchal translucency (NT) was measured as per criteria. Nasal bone hypoplasia, frontomaxillary facial angle and ductus venosus Doppler was also included in all scans. Fetal head was examined for shape, choroid plexus and bilateral ventricular size. Other structural anomalies including abdominal organs, spine, limbs and limb movements were examined. Fetal heart rate and cardiac chambers were seen in all scans to look for any cardiac anomalies and fetal echocardiography was done, whenever there was any suspicion of cardiac anomaly or aneuploidy. Umbilical cord, quantity of liquor, position of placenta and cervical length were measured. Estimated risks for aneuploidy (trisomy 13, 18 and 21) were calculated based on maternal age and anomaly scan. It was calculated by FMF-2009 software, which is based on findings from extensive research coordinated by the fetal medicine foundation (UK Registered charity 1037116).

Second trimester scan was conducted at 18 to 22 weeks gestation. The results of the first trimester anatomic survey were correlated with second trimester target scan, postnatal findings, and chromosome analysis whenever done, to evaluate value of first trimester scan for early detection of anomalies. All the patients were followed up till delivery. Newborn examination was performed by pediatricians after delivery.

**Data Analysis**

Data was analyzed using statistical software SPSS version 20.0. Categorical variables were analyzed using chi-square test, while continuous variables were analyzed using Student's t-test and ANOVA. P-value less than 0.05 were taken as statistically significant.

**Results**

A total of 1500 women visited the antenatal clinic during the study period. Out of which 321 women were excluded as per exclusion criterion mentioned above. One hundred and thirty two women were lost to follow up and therefore excluded from the study.

As per inclusion criteria there is significant difference in age and gravida in both groups (*Table 1)*. Though

***Table 1. Distribution of Patients Based on Gravida, Parity, Live Issues and Abortions***

| | Low risk (n=551) | High Risk (n=496) | p-value |
|---|---|---|---|
| Age(Years) | 24.8±2.6 | 27.2±4.3 | 0.001 |
| BMI | 24.04 ±4.83 | 25.02 ±4.85 | 0.973 |
| Gravida | | | |
| G1 | 300 (54.4) | 101 (20.4) | |
| G2 | 190 (34.5) | 107 (21.5) | |
| G3-4 | 61 (11.1) | 225 (45.4) | |
| >G5 | 00 | 63 (12.7) | <0.0001 |
| Parity | | | |
| P0 | 300(54.4) | 162 (32.7) | |
| P1 | 190 (34.5) | 171(34.5) | |
| P2-3 | 61 (11.1) | 144 (29.0) | |
| ≥P4 | 00 | 19(3.8) | <0.0001 |

***Table 2. First Trimester Anomaly Scan (FTAS)***

| | First Trimester Anomaly Scan | | Mid Gestation Ultrasound Scan | |
|---|---|---|---|---|
| | Low Risk (n=551) | High risk (n=496) | Low Risk (n=547)# | High Risk High risk (n=478)# |
| Anencephaly | 0 | 1 | 0 | 0 |
| Acrania | 0 | 1 | 0 | 0 |
| Cystic hygroma | 1 | 2 | 1 | 0 |
| Choroid plexus cyst | 1 | 1 | 0 | 0 |
| Holoprosencephaly | 0 | 1 | 0 | 0 |
| Omphalocele | 1 | 1 | 0 | 1 |
| Hydrocephalus | 0 | 1 | 0 | 1 |
| Hydrops | 0 | 1 | 1 | 1 |
| Spina bifida | 0 | 2 | 0 | 1 |
| Talipes Bilateral | 0 | 1 | 0 | 0 |
| Congenital Heart Disease | 0 | 3 | 0 | 1 |
| Unilateral Renal agenesis | 0 | 0 | 1 | 1 |
| Bilateral Renal Agenesis | 0 | 0 | 0 | 1 |
| Achondroplasia | 0 | 0 | 0 | 0 |
| Total | 3 | 15 | 3 | 7 |

*# 3 women in low risk group and 17 in high risk group underwent medical termination of pregnancy after FTAS. Two patients (1 each in both groups) had spontaneous abortion in 2nd trimester.*

slightly higher BMI was observed in high risk group, the differences was statistically not significant (p value >0.05).

Mean gestational age, when FTAS was done, was similar in both low and high risk groups (12.48 ±0.80 and 12.7 ±0.69 weeks respectively). NT was with in normal limits in all patients in low risk groups. Seven (1.4%) patients in high risk group had NT above 95$^{th}$ centile. Triple test was performed in all seven cases which was suggestive of risk factors for trisomy's in 3 fetuses. Invasive prenatal diagnosis by amniocentesis was performed in all three patients after proper counseling and karyotyping was performed, which shows the presence of trisomy 21 in two fetus and trisomy 18 in one fetus. Prevalence of congenital anomalies detected by FTAS in low risk group was 0.72% (n=3), while in high risk group the prevalence was 3.6% (n=15). Couples were counseled for the risk factors associated with congenital and chromosomal abnormalities and they opted for medical termination of pregnancy. Mid-gestation ultrasound scan was done between 18 to 23 weeks in all

patients in both groups. Mean gestational age when mid gestation ultrasound was done, was also similar in both the groups (19.2 ±0.80 and 19.5 ±1.08 weeks respectively). Congenital anomalies were detected in 3 additional patients from low risk group and in 7 additional patients from high risk group that were missed by FTAS. (*Table-2*) Overall prevalence of congenital anomalies in study population was 2.6%. Out of these 64.4% were detected by first trimester anomaly scan, while another 35.6% were detected by mid gestation scan. Combination of FTAS and mid-gestation scan was able to detect all the clinically important congenital anomalies; however, most of these were detected much earlier with use of FTAS. No false positive cases were detected by FTAS.

**Discussion**

Prenatal diagnosis consists of biochemical markers examined in the maternal serum and ultrasonographic fetal organ scanning for fetal structural anomalies. Traditionally, the main ultrasound examination during pregnancy was performed in the second trimester using transabdominal transducers. This detailed second trimester (18-23 weeks of gestation) anomaly scan is the standard of care all over the world. However, since 1990s, the emphasis has shifted to the first trimester when it was realized that the great majority of fetal anomalies can be identified by a combination of first trimester anomaly scan (FTAS) and maternal serum biochemical markers. (5)

The benefits of scanning in early pregnancy are therefore divided into several levels: first, earlier diagnosis of normal and abnormal intrauterine pregnancy and the detection of ectopic pregnancy; second, more accurate dating of early pregnancies on the basis of the measurement of the gestational sac and the crown-rump length; third, measuring the nuchal translucency (NT) at 12 to 14 gestational week as a marker for chromosomal abnormalities (mainly Down syndrome) and certain organ anomalies (mainly in the cardiovascular system); fourth and perhaps most importantly, the ability to detect structural anomalies during the first and early second trimester of pregnancy. (5)

Most of the previous studies were based on older patients. Becker *et al* (6) studied potential of FTAS as screening procedure in medium risk population of 6845 women with median age of 35 years (range 15-45 years). Audibert *et al* (7) study population with mean age of 30.1 years (range 16-37 years). Another study by Schuchter *et al* (8), reported a median maternal age 28 (range 15-46 years) in study population. Similarly, Schwarzler *et al* (9) reported a mean maternal age of 29.4 years for in unselected study population. In present study, the mean age of the study population (both high and low risk groups) was much lower compared to previous studies. Early age of marriage and cultural factors are probably responsible for this age difference. Besides, most of the earlier studies were focused on high risk patients, while both groups were enrolled in the present study.

Schwarzler *et al* (9) shows that there was no strong association between cardiac abnormalities and increased nuchal translucency. In present study, three babies had congenital heart disease, among which only one had increased NT and remaining 2 had normal NT measurement, reaffirming the findings of the previous study, suggesting that NT measurement alone has poor sensitivity for detection of congenital heart disease and FTFE should be done, whenever required for diagnosis of congenital heart disease. Hafner *et al* (10) and Taipale *et al* (11) have assessed the value of nuchal translucency screening in low risk populations, and reported a lower sensitivity than that found in high risk groups.

Smrcek *et al* (12) studied the role of FTAS including fetal echocardiography for early detection of congenital heart disease. Twenty-nine (63%) congenital heart disease could be diagnosed in first trimester, 9 (19.5%) were diagnosed in second trimester, 2 (4.3%) in third trimester and 6 (13%) were detected postnatally. In present study we also were able to find out the CHD in 3 fetuses at first trimester and one at mid trimester. This study also suggested that early fetal echocardiography is feasible and allows the detection of most CHD.

FTAS demonstrated high specificity (100%), however, the sensitivity was only 64.4%. Hence, alone it cannot be used for screening of congenital anomalies but it demonstrated high specificity for early detection of congenital anomalies.

Prevalence rate for congenital anomalies varied from 1.2% to 4.6% among the studies, likely reflecting the referral population and the extent of follow up and ascertainment of anomalies. Studies involving the minor anomalies reported higher prevalence than the studies focusing only on major anomalies. Similarly, studies involving only high risk populations also reported higher prevalence. (2) Diagnostic accuracy of first trimester anomaly scan was reported varying from 17% to 61% in a review focusing on unselected population. The detection rates increased to 59-88% in 20 week scan. (13) Other previous studies have also reported detection rates ranging

from 22% to 61% for major fetal anomalies by FTAS. (1) Similar results were obtained in present study where 64.4% patients could be detected by FTAS, while the detection rate increased to 100% at mid-gestation scan.

Screening by FTAS alone was employed in both groups in present study with a detection rate of 33% in low risk patients. However, the detection rate increased to 100% with a sequential mid-gestation scan. Thus, sequential screening employing FTAS followed by mid gestation scan was able to detect all the anomalies in the present study. Maternal serum biochemistry was done in only selective cases and that did not detect any additional case of aneuploidy. So, sequential screening by FTAS and mid-gestation may be considered as a good policy for antenatal detection of congenital anomalies and is more acceptable and feasible to the patients as well. Besides anomaly screening, mid-gestation scan provides lot of other information regarding fetus, amniotic fluid and placenta. Routine maternal biochemistry screening is less feasible option in low risk population, particularly in a developing country, like us. However, none of our patients had aneuploidy, and we had a small sample size, so exact role of this sequential screening by two scans for aneuploidy detections could not be ascertained.

Thus, with the growing success in identifying fetal anatomic structures and structural anomalies in the first trimester, it is possible to identify these anomalies by first trimester anomaly scan. Hence, there is growing acceptance that at least in high risk pregnancies, detailed first trimester anomaly scan and first trimester fetal echocardiography should be performed to detect the fetal anomalies early. (6) Use of FTAS has reduced use of invasive testing in a majority of patients.

Early diagnosis of presence or absence of congenital anomalies is beneficial to mother, both physically and psychologically. A negative sonogram is certainly reassuring particularly for the couples with an increased risk of fetal anomalies. This reassurance was particularly seen in parents with previous congenital anomalies, where normal early scan reduced the anxiety levels to a great extent. On the other hand, anticipation of a positive diagnosis may be valuable in itself. Earlier detection of fetal structural malformations would allow for earlier antenatal referral to a tertiary care facility and coordination of care among appropriate subspecialists. (14) Parents are mentally prepared for these anomalies and a better co-ordination with specific sub-specialties can be assured to the baby.

**References**


1. Rossi AC, Prefumo F. Accuracy of ultrasonography at 11-14 weeks of gestation for detection of fetal structural anomalies: a systematic review. *Obstet Gynecol* 2013;122(6):1160-7.
2. Fong KW, Toi A, Salem S. Detection of fetal structural abnormalities with US during early pregnancy. *Radiographics* 2004;24:157-74.
3. D'ottavio G, Mandruzzato G, Meir YJ. Comparison of first and second trimester screening for fetal anomalies. *An N Y Acad Sci* 1998; 847:200-9.
4. Chen M, Lee CP, Lam YH. Comparison of nuchal and detailed morphology ultrasound examinations in early pregnancy for fetal structural abnormality screening: a randomized controlled trial. *Ultrasound Obstet Gynecol* 2008;31:136-46.
5. Katorza E, Achiron R. Early pregnancy scanning for fetal anomalies- the new standard? *Clin Obstet Gynecol* 2012;55(1):199-216.
6. Becker R, Albig M, Gasiorek-Wiens A. The potential of first trimester anomaly scan and first trimester fetal echocardiography as screening procedure in a medium risk population. *J Obstet Gynecol India* 2005;55(3):228-30.
7. Audibert F, Dommergues M, Benattar C, *et al*. Screening for Down syndrome using first trimester ultrasound and second trimester maternal serum markers in a low-risk population: a prospective longitudinal study. *Ultrasound Obstet Gynecol* 2001;18:26-31.
8. Schuchter K, Hafner E, Stangl G, *et al*. Sequential screening for trisomy 21 by nuchal translucency measurement in the first trimester and, maternal serum biochemistry in the second trimester in a low risk population. *Ultrasound Obstet Gynecol* 2001;18:23-5.
9. Schwarzler P, Carvalho JS, Senat MV. Screening for fetal aneuploidies and fetal cardiac abnormalities by nuchal translucency thickness measurement at 10-14 weeks of gestation as part of routine antenatal care in an unselected population. *Br J Obstet Gynaecol* 1999; 106:1029-34.
10. Hafner E. Schuchter K, Liebhart E, *et al*. Results of routine fetal nuchal translucency measurement at weeks 10-13 in 4233 unselected pregnant women. *Prenat Diagn* 1998; 18:29-34.
11. Taipale P, Hiilesmaa V, Salonen R, *et al*. Increased nuchal translucency as a marker for fetal chromosomal defects. *N Engl J Med* 1997;337: 1654-8.
12. Smrcek JM, Berg C, Geipel A. Detection rate of early fetal echocardiography and in utero development of congenital heart defects. *J Ultrasound Med* 2006; 25:187-96.
13. Ghi T, Pilu G, Savelli L, *et al*. Sonographic diagnosis of congenital anomalies during the first trimester. *Placenta* 2003; 24: S84-S87.
14. Timor-Tritsch IE, Fuchs KM, Monteagudo A, *et al*. Performing a Fetal Anatomy Scan at the Time of First-Trimester Screening. *Obstet Gynecol* 2009;113:402-7.