ORIGINAL ARTICLE

ULTRASONOGRAPHIC EVALUATION OF FETUS BETWEEN 11 TO 14 WEEKS OF GESTATIONAL AGE: A CROSS SECTION STUDY CONDUCTED IN A TERTIARY CARE HOSPITAL OF GUJARAT

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ABSTRACT

Background: Over the past decade, prenatal diagnosis has shifted rapidly from the second trimester into first trimester. The recent development of high frequency transvaginal ultrasound transducers has led to vastly improved ultrasound resolution and improved visualization of fetal anatomy earlier in gestation in 11 to 14 weeks of ultrasonographic scan. The early scan also provides reliable identification of chorionicity, which is the main determinant of outcome in multiple pregnancies.

Objectives: This study was conducted for diagnose or suspect a wide range of structural and chromosomal anomalies of fetus; investigate the complication of early pregnancy; confirm viability; accurately date the pregnancy and diagnosis of multiple pregnancy & determination of chorionicity & amnionicity.

Methods: Ultrasound screening transabdominally and transvaginally was performed at 11–14 weeks in randomly selected cases of 150 pregnant women who attended our hospital from September 2007 to September 2009.In present study, ultrasound machine of high accuracy was used. Ultrasound examination was performed transabdominally and transvaginally

Result: 45.45% structural anomalies were detected in 11 to 14 weeks USG scan, 36.36% structural anomalies were detected in 2nd trimester (18-22 weeks) USG scan and 18.18% structural anomalies were detected postnatally. Incidence rates of structural anomalies detected in 11 to 14 weeks USG scan, 2nd trimester USG scan and postnatally were 3.3%, 2.6% and 1.4% respectively with total incidence rate of 7.3%. Detection rate of structural anomalies in 11 to 14 weeks USG scan & combined USG scan was 71.42% & 81.8% respectively. Highest number of structural abnormalities that is 34%, detected in CNS; out of these, 100% of them had NTDs.

Conclusion: The concepts of first trimester scan solely to confirm viability or date of pregnancy should be abandoned and attempt should be made to visualize fetal anatomy in detail.

Keywords: Ultrasonography, fetus, gestational age, 2nd trimester, structural anomalies G

INTRODUCTION

An understanding of embryonic development and appreciation of sonographic appearances of normal anatomy in the 11–14 weeks of pregnancy are essential to detect structural anomalies. Most of congenital malformations originate during the embryonic period.[1, 2] 11 weeks of gestation is the earliest gestation for diagnosis of many major fetal defects. For example, diagnosis & exclusion of acrania and therefore anencephaly, cannot be made before 11 weeks because sonographic assessment of ossification of the fetal skull is not reliable before this gestation.[3] Examination of the four chamber view of the heart and main arteries is possible only after 10 weeks. At 8-10 weeks, all fetuses demonstrate herniation of midgut that is visualized as a hyperechoic mass in the base of the umbilical cord, and it is therefore unsafe to diagnose or exclude exomphalos at this gestation. Fetal bladder can be visualized in only 50% of fetuses at 10 weeks, in 80% at 11 weeks and in all cases by 12 weeks. The reasons for selecting 13 weeks and 6 days as the upper limit are firstly, to provide women with affected fetuses the option of first trimester or early second trimester rather than late second trimester termination and secondly the incidence of abnormal accumulation of nuchal fluid in chromosomally abnormal fetuses is lower at 14-18

weeks than before 14 weeks. So, some of the phenotypical expression of chromosomal abnormalities could be detected by TAS/TVS especially at 11-14 week scan. This when combined with some maternal serum markers can increase the sensitivity of detection. The vast majority of pregnant women prefer screening & diagnosis to be performed at the 11 to 14 weeks, rather than in second trimester. This is due to early diagnosis of fetal abnormality & the option of early termination of pregnancy in many women who would not prefer an invasive procedure. Until recently, attempts to detect fetal disorders of non chromosomal origin during the first trimester have mostly been confined to high-risk groups and/or selected populations. Although evidence is increasing that early ultrasonography in screening low-risk pregnancies for fetal structural defects might also be feasible, experiences in screening large populations are required.

OBJECTIVES

- To compare different type of structural anomalies of different system & try to know incidence of anomalies in each system.
- To compare incidence of fetal anomalies detected in 11-14 weeks scan & 18-22 weeks scan.
- To know comparison of increased nuchal translucency & structural fetal anomalies & outcome of pregnancy.
- To know the efficacy & efficiency of 11-14 weeks of fetal scan for being efficient screening programme.
- To investigate the complication of early pregnancy, confirm viability. accurately date the pregnancy and diagnosis of multiple pregnancy & determination of chorionicity & amnionicity

MATERIALS AND METHODS

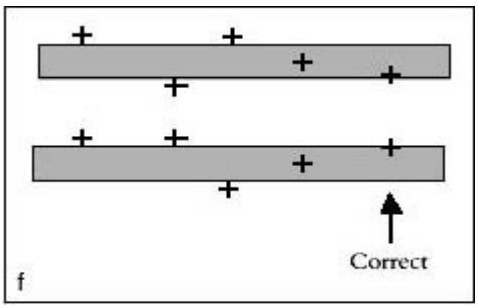
Ultrasound screening was performed at 11–14 weeks in randomly selected cases of 150 pregnant women who attended V. S. General Hospital, NHL Medical College, Ahmedabad from September 2007 to September 2009.In present study, ultrasound machine of high accuracy was used. Ultrasound examination was performed transabdominally and transvaginally. Details of ultrasonography machine & probes are as follows:

Esaote Mylab 50: TAS- 2.5-5 MHz, TVS- 5-7.5 MHz
LOGIQ Wipro: TAS- 3.5-5 MHz, TVS- 6-10 MHz

Ultrasonography was done by expert sonographer. In present study both 11-14 weeks and 18-22 weeks ultrasonographic scans were done. Fetal evaluation was performed routinely by transabdominal approach. When visualization of fetal structures was suboptimal or a structural abnormality was suspected during transabdominal scan, transvaginal scan was always performed. Whenever required, doppler ultrasound was also performed. If it was not possible to clearly visualize stomach or urinary bladder at first attempt, scan was repeated after 1 hour. Fetal viability was examined and crown-rump length (CRL), biparietal diameter (BPD), and femur length (FL) were measured.

Measurement of nuchal Translucency

Nuchal Translucency is maximum thickness of the subcutaneous tissue between the skin & the soft tissue overlying the cervical spine of the fetus at 11 to 14 weeks gestation. For measurement of NT, The gestation was between 11 wks & 1 day to 13 wks & 6 day. The fetal crown rump length was between 45 to 84 mm. A good sagital section of fetus as for measurement of fetal CRL, was obtained & the NT was measured with the fetus in neutral position. Care must be taken to distinguished between fetal skin & amnion. The magnification was such that the fetus occupies the entire image. Essentially, the aim was that each movement to the calipers produces 0.1mm change in the measurement. The maximum thickness of blank space between the soft tissue overlying the cervical spine & skin was measured. During scan, more than one measurement was taken and the maximum one was recorded. Measurement was taken with the horizontal lines of calipers placed on the lines that define the nuchal translucency thickness (Not in the line & not in the nuchal fluid) as shown in diagram:



Measurement of fetal nasal bone

A mid sagittal view of fetal profile was obtained. The image was magnified so that only the head & upper thorax ane included in screen. The angle between the ultrasound transducer & an imaginary line passing through the fetal profile from the forehead to the chin was about 45 degrees. After gentle tilting of transducer from one side to the other side of the fetal nose, three distinct lines were seen. The first two, which were proximal to the forehead, were horizontal & parallel to each other, resembling an "equal sign" the top line represented the skin & more echogenic than the overlying skin- represented the nasal bone and the third line almost in continuity with the skin, but at a higher level, represent the tip of the nose.

Facio Maxillary Angle

A mid sagittal view of the fetal profile was first obtained & transducer is then gently angled laterally to that both the maxillary bone & mandible, including ramus & condylar process, was seen. It was screening tool for chromosomal anomalies like Down's syndrome & facial malformations.

Lethal, incurable, or curable severe abnormalities with a

high risk of residual handicap were considered major structural abnormalities. Less severe or benign abnormalities constituted the group of minor structural abnormalities. The findings were noted as shown in proforma. Maternal serum chemical markers were not done as they are expensive and not available at our institute. In present study, all pregnancy outcomes were followed up.

RESULTS

In present study, analysis of data of 150 randomly selected women with 11 to 14 weeks of gestational age has been done. Majority of women were in age group 21-25(60.66%) with mean age of 25 year. Highest numbers of structural anomalies, 45.44%, were detected in 20 or less than 20 years of maternal age. Incidence of women with structural anomalies was higher, 25%, in more than 25 years of age group.

Table 1: Detection of structural anomalies

Structural Anomalies Detected	Cases (%)	Incidence Rate
11 To 14 Weeks USG Scan	05 (45.46)	3.3
Cystic hygroma	1	
Skeletal dysplesia	1	
Multiples system defects*	1	
Anencephaly	2	
2nd Trimester USG Scan	04 (36.36)	2.6
Cleft lip & cleft palate	1	
Unilateral Multicystic kidney disease	1	
Hydrops fetalis	1	
Hydrocephalus	1	
Not Detected in Any USG Scan but Detected after Delivery	02 (18.18)	1.4
Hypospadiasis	1	
Anterior chest wall hemartoma, megacystis & low set ears	1	
Total	11	7.3

***** includes hydrocephalus, open spina bifida, open anterior abdominal wall, open chest wall & heart and exomphalos

Highest numbers of structural anomalies, 63.63%, were detected in primi gravida with higher incidence rate of 14.89%.3(2%) structural anomalies were detected in previous newborn or fetus, out of them 1(0.66%) had anencephaly & 2(1.34%) hydrocephalus. In present study, the women having past history of structural anomalies in previous newborn or fetus had normal 11 to 14 weeks USG scan of fetus.

The present study shows that 5(45.45%) structural anomalies were detected in 11 to 14 weeks USG scan, 4(36.36%) structural anomalies were detected in 2nd trimester (18-22 weeks) USG scan and 2(18.18%) structural anomalies were detected postnatally(Table 1).Incidence rates of structural anomalies detected in USG at 11 to 14 weeks, 2nd trimester USG scan and postnatally were 3.3%, 2.6% and 1.4% respectively with total incidence rate of 7.3%. More than one anomaly was present in single fetus.

According to Table 1, five structural anomalies were detected in 11 to 14 weeks USG scan but two structural anomalies cleft lip-cleft palate and hydrocephalus were not detected in 11 to 14 weeks USG scan. These were detected in 18-22 weeks USG scan. Unilatreal Multicystic kidney disease & Hydrops fetalis were not detected in 11 to 14 weeks USG scan. These can only be detected in 2nd trimester scan. Sensitivity and specificity of detection of structural anomalies in 11 to 14 weeks USG scan was 71.42% & 100% respectively.

According to Table 1, four structural anomalies were detected in 2nd trimester USG scan but two structural anomalies Hypospadiasis and Anterior chest wall hemartoma-megacystis-low set ears were not detected in 18-22 weeks USG scan. These were detected postnatally. But when we combine results of structural anomalies, detected in 11 to 14 weeks USG scan and in 2nd trimester USG scan, out of 11 only 2 structural anomalies were not detected. Sensitivity and specificity of detection of structural anomalies in combined 11 to 14 weeks USG scan & in 2nd trimester USG Scan was 81.8% & 100% respectively.

Out of 150 fetuses, 96% of fetuses were viable and 4% fetuses had no cardiac activity. Incidence rate of spontaneous & induced abortions in 11 To 14 weeks was 8.6%. Out of 150 cases, 0.66% extra uterine abdominal pregnancy was detected at 13 weeks 4 days of gestational age and emergency laparotomy was performed. Incidence rate of twins pregnancy detected in present study was 1.33%. Both twin pregnancies were dichorionic diamniotic. There were 2% of low lying placenta, 1.34% of retroplacental clot & 0.66% of vesicular mole found in our study.

Correlation between CRL (mm) & Gestational Age (weeks) is established and all fetuses were found in normal range. Chi-Square Tests were applied to establish correlation between CRL (mm) & NT (mm) in 11 to 14 weeks scan and results of Chi-Square Tests shown strong correlation between CRL(mm) & NT(mm)(P Value < 0.05). Nasal bone was visualized in all fetuses at 11-14 weeks in present study.

45.45% structural anomalies were detected in 11 to 14 weeks USG scan, 36.36% structural anomalies were detected in 2nd trimester (18-22 weeks) USG scan and 18.18% structural anomalies were detected postnatally. Detection rate of structural anomalies in 11 to 14 weeks USG scan & combined USG scan was 71.42% & 81.8% respectively. Highest number of structural abnormalities that is 41.66 %, detected in CNS.

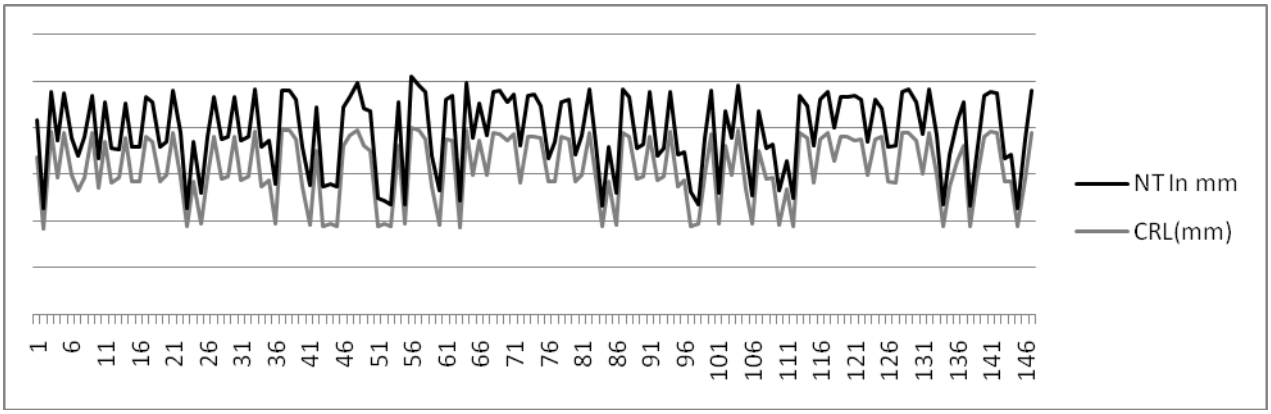


Figure 1: Correlation Between CRL (mm) & NT (mm)

Pregnancy outcome was noted. In present study, 59.06% were delivered at full term, 7.57% had preterm deliveries and 32.57% underwent cesarean section. Perinatal outcome was noted. Structural anomalies were detected in 3.03% fetuses; of which 2 structural anomalies, cleft lip-cleft palate and unilateral multicystic kidney disease were detected at 18-22 weeks scan. Hypospadiasis & anterior chest wall hemartoma-megacystis - low set ears were not detected by USG but diagnosed postnatally. 6.06% babies were admitted in NICU for birth asphyxia, thick meconium aspiration & low birth weight.

DISCUSSION

Table 2 shows the incidence rate of Structural Anomalies in different types of studies ranges between 3.2 to 4.6 %. In Carvalho et al, Brazil study[6]. There were 2853 unselected women screened prospectively at 11-14 weeks of gestation. Defects were detected in 130 (4.6%) at 11 to 14 weeks scan. 78.5% of major defects were diagnosed by prenatal scan and 37.8% by the 11-14 weeks scan. In Markov et al, Bulgaria study[7], there were 1135 low risk pregnant women detected 53 (4.6%) structural anomalies with detection rate of 22% in the 11-14 weeks scan & 69% in 2nd trimester scan. Saltvedt et al study[9], Sweden, the largest study of this nature, was conducted in Sweden between 1999 and 2002, 39572 women were randomized to one routine scan at either 12-14 weeks of gestation or 15-22 weeks of gestation. Out of 1252 (3.5%) structural anomalies detected, 38% detected at the time of the early anatomic survey & 47% of malformations were detected by the later anatomic survey. R. Mangione et al study[13], France was low risk group study conducted on 10800 women. 336 fetuses with malformations were screened out with 50% & 72% detection rate in 11 to 14 weeks scan & in 2nd trimester scan. Death in utero occurred in 9% of cases. In 4.9% of cases, an abortion was performed. In present study incidence of major structural anomalies was 7.3%. The high incidence rate was attributed to small sample size and random selection of the patients in present study.

Table 2: Comparison of structural anomalies detected in present study & other studies

Studies Detecting Structural Anomalies in 11 To 14 Weeks USG Scan	Incidence Rate of Detecting Structural Anomalies in 11 To 14 Weeks USG Scan (%)
Carvalho et al [6], 2002	4.6
Markov et al [7], 2004	4.6
Saltvedt et al [9], 2006	3.5
R. Mangione et al [13], 2008	3.2
Present Study	**7.3**

Table 3: Comparison of detection rates of_structural anomalies detected in 11 To 14 weeks USG scan & combined 11-14 weeks & 2nd trimester USG scan in present study & other studies

Studies Which Detecting Structural Anomalies	Detection Rate of Structural Anomalies in 11 To 14 Weeks USG Scan (%)	Detection Rate of Structural Anomalies in Combined 11-14 Weeks & 2nd Trimester USG Scan (%)
Souka et al [8], 2006	50	93
Dane et al [11], 2007	71	95
Chen et al [12], 2008	48	66
Ozetekin et al [4], 2009	66	90
Present Study	71.42	81.8

Table 4: Structural anomalies detected in 11 to 14 weeks USG scan & in 2nd trimester USG scan (n=12)

Structural Anomalies	Cases (%)
Central Nervous System & NTD	5 (41.66)
Hydrocephalus	2
Anencephaly	2
Open spina bifida	1
Face & Neck	2 (16.66)
Cleft lip & cleft palate	1
Cystic hygroma	1
Anterior wall Defect	2 (16.66)
Open chest wall & heart	1
Exomphalos	1
Genitourinary System	1 (8.33)
Unilateral Multicystic kidney disease	1
Musculoskeletal System	1 (8.33)
Skeletal dysplesia	1
Other	1 (8.33)
Hydrops fetalis	1

Table 3 shows that detection rate of structural anomalies in 11 to 14 weeks USG scan in different studies ranges from 50% to 71%. Present study shows detection rate 71.4%. Detection rate of structural anomalies in combined 11-14 weeks & 2nd trimester USG scan in different studies ranges from 66% to 95%. Present study shows detection rate 81.8%.Higher detection rates were attributed to good ultrasonography machine and expert sonologist.

According to table 4, 12 anomalies were detected in 9 fetuses (so, in 1 fetus more than one anomaly was present). 41.66% of structural abnormalities were detected in CNS. 16.66 % of anomalies were detected in face & neck. Anterior wall defect was found in 16.66 %. 8.33 % of anomalies were detected in genitourinary system.8.33 % anomalies were detected in musculoskeletal system. 8.33 % had Hydrops fetalis. Table 5 shows that in all studies, CNS abnormalities were most common. In present study also, highest (41.66%) abnormalities were found in CNS.

Table 5: Comparison of System Wise Structural Anomalies Detected In 11 To 14 Weeks USG Scan & In 2nd Trimester USG Scan in Present Study & Other Studies

Affected System or Organ	Guarigia et al [5], 2000	Cedergren et al [10], 2006	R.Mengione et al [13], 2008	Oztekin et al [4], 2009	Present Study
Central & Peripheral Nervous System	39	36.53	36.73	36.35	41.66
Face	-	2.84	2.04	-	16.66
Neck	2.5	25	14.28	18.18	
Cardiovascular System	5	19.23	6.1	9.0	-
Respiratory System	11	5.77	18.36	-	-
Gastrointestinal System	11	13.5	4.08	18.18	-
Genitourinary System	18	5.77	16.32	9.0	8.33
Musculoskeletal System	12	16.25	18.36	9.0	8.33
Anterior wall defect	-	-	-	-	16.66
Others (Hydrops fetalis)	-	-	-	-	8.33

CONCLUSION

With good USG machine & training, one can detect fetal structural anomalies with high efficacy even in 11-14 weeks scan. The concepts of first trimester scan solely to confirm viability or date of pregnancy should be abandoned and attempt should be made to visualize fetal anatomy in detail. But, there are certain anomalies that can only be detected in 2nd trimester scan. Hence, for detection of structural anomalies, both 11-14 weeks scan & 2nd trimester scan are required and are complementary to each other.

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