Original Article

Sonographic measurement of the atrium of fetal lateral ventricle in low risk population of pregnant women at 16-38 weeks of gestation.

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Abstract

Introduction: The purpose of this study was to establish the size of atrium of fetal lateral ventricle and to evaluate its changes in normal fetuses in low risk population of pregnant women in the second and third trimesters of pregnancy.

Methods: This was a prospective cross-sectional study involving 290 women with uncomplicated singleton gestation between 16-38 weeks. Atrium was visualized in 264 cases. The fetal biparietal diameter (BPD) was measured first. Atrium was measured at the level of the glomus of the choroid plexus, perpendicular to the ventricular cavity, positioning the calipers inside the echoes generated by the lateral walls. Nomogram of the sizes of atrium was prepared.

Results: Atrium was visualized in 91% of the fetuses. The ages of the patients ranged from 17-30 years (mean 24.29, SD 2.78). The maximum numbers of case were at 23 and 27 weeks of gestation and the minimum number of cases were at 37 weeks of gestation. The mean size of the atrium of lateral ventricle was 6.28mm, (SD1.2; range 3.5-8.9 mm). The size of atrium showed significant positive correlation with gestational age (r2 value of 0.78; $p<0.001$ for atrium)

Conclusion: Atrium of lateral ventricle showed continuous increment and showed significant correlation with the gestational age. The findings were consistent with the previous studies done by various authors. The percentile fitted values and nomograms will be valuable for the serial measurement of the atrium of lateral ventricle for complicated pregnancies.

Key words: ventricle, atrium,

Introduction

Central nervous system (CNS) malformations account for the most common congenital fetal abnormalities. Due to recent advances in antenatal sonography most of the CNS abnormalities can be accurately diagnosed as early as second trimester of pregnancy.[1-3] Among the various CNS malformations, neural tube defects are the most frequently encountered in routine practice. The incidence of neural tube defects is approximately 1-2 cases per 1000 births. However the incidence of CNS abnormalities with normal neural tube is uncertain because most of them are not diagnosed at birth and then only manifest in later life. Studies however suggests that the incidence may be as high as one in 1000 birth.[4]

Ultrasound has been used for many years as the investigation of choice to diagnose various congenital CNS abnormalities. Study carried out by Levi S showed that the sensitivity of ultrasound for the detection of fetal congenital anomaly was 88.3%.[5]

The antepartum obstetrical ulyrasound examination guidelines mandate that the examiner visualizes the fetal cerebral ventricles in all sonograms performed during the second and third trimester. The observation of fetal ventriculomegaly offers the best opportunity to detect the malformation of CNS, and the ventricular

atrium is the easiest portion of the ventricular system to make such observations.[6]

The study was carried out to study the size of atrium of fetal lateral ventricle in uncomplicated pregnancy at 16-18 weeks of gestation, to construct the reference table and correlate size of atrium of fetal lateral ventricle with GA.

Methods

This was a prospective cross sectional study involving 290 uncomplicated singleton pregnancies between 16-38 weeks of gestation without any known risk factors of adverse pregnancy outcome who were referred for routine obstetric scan. The study was conducted in Department of Radiology, Tribhuvan University Teaching Hospital. Medical ethics committee, Institute of Medicine approved the study protocol and all the patients gave prior informed consent. Multiple pregnancy, undetermined period of gestation, diagnosed fetal abnormality in the current pregnancy, previous history of preeclampsia, intrauterine growth retardation, abruption placenta or preterm delivery, bad obstetric history, maternal history of any pre-existing medical disease such as hypertension, diabetes mellitus, renal disease and fetus with obvious risk of developing fetal anaemia including Rh negative women were not included in study.

The protocol included measuring the known biometric parameters to confirm the gestational age. The obstetric scan was done with the patient in supine position and required biometric parameters were obtained with commercially available, B-mode ultrasound unit equipped with 3.5 MHz curvilinear transducer probe by a single examiner. Conventional measurements of the BPD were obtained in all cases from a transverse axial plane of the fetal head showing a "arrow like " appearance with a central midline echo broken in the anterior third by the cavum septum pellucidum and the frontal horns of the lateral ventricles (feathers). The third ventricle and sylvian aqueduct were the "shafts". The ambient and quadrigeminal cisterns and the tentorial hiatus were the "arrowhead". It was ensured that the calvaria are smooth and symmetric bilaterally. The BPD was measured as the widest diameter across the thalamus, from the outer edge of the near calvarial wall to the inner edge of the far calvarial wall. Atrium was measured at the level of the glomus of the choroid plexus, perpendicular to the ventricular cavity, positioning the calipers inside the echoes generated by the lateral walls.

Data obtained from the predesigned collection sheet were compiled. SPSS 17 was utilized for the data analysis and presentation. Descriptive statistics, diagrams, scatter diagrams, histogram, correlation coefficient and linear regression were used. Nomograms and percentile fitted curves were obtained.

Results

This was a prospective study carried out on 290 singleton uncomplicated pregnancies between 16 and 38 weeks of gestation meeting the inclusion criteria. 26 cases (9%) were excluded due to poor sonographic visualization of the fetal atrium. Most of these excluded cases were in late third trimester. This was because of difficulty in penetrating the cranium and reverberations from calvarium. Another reason for inadequate visualization of atrium was fetal position and maternal body habitus like obesity.

Maternal age ranged from 17 to 31 years with the mean age being 24.29 ± 2.78 years. Most of the cases were between 22 to 29 years. (Figure 1)

Pregnancies between 16 - 38 weeks of gestation were studied with maximum number at 23 and 27 weeks of GA. Minimum number of pregnancies was at 37 weeks. (Figure 2)

Mean size of atrium of lateral ventricle was 4.3±0.866 at 16 weeks of gestation which increased to 8.1±0.46 at 38 weeks. (Table 1)

Gestational age specific nomograms with 5th, 50th and 95th percentile fitted lines show continuous increment of the size of atrium with increasing GA. (Table 2; Figure3)

There was linear correlation between the sizes of atrium with GA. (Figure 4)

A second-degree polynomial equation was obtained for adequate description of the data. The specific equation to describe the relationships between the biometric parameters and the menstrual age is:- Atrium = 1.443 + 0.189 GA ($p<0.001$); R2 = 0.72 (Table 3)

Discussion

Cross-sectional observations were obtained in 264 women with uncomplicated singleton pregnancies between 16-38 weeks of gestation. The mean size of the atrium of lateral ventricle was 6.28mm, (SD, 1.2; range, 3.5-8.9 mm). The mean size of the atrium was similar to those reported by Hilpert et al[7] and Almog et al.[8]

In a study conducted by Hilpert et al[7] in 608 patients between 13 to 42 weeks of GA, the mean size of atrium was 6.5 mm (SD 1.5mm; range 3-11mm). In another study done by Almog et al[8] in 427 cases between 20

and 40 weeks GA, it was found that the mean size of atrium of lateral ventricle was 6.2 mm (SD, 1.2). The mean size of the atrium in our study is also similar to the study of Pilu et al, [9] where 171 fetuses had the mean atrial size of 6.9mm (SD 0.65). However the SD was nearly double in our study as compared to their study.

The mean size of atrium as well as SD calculated in our study also differed from the study done by Cardoza et al,[10] who retrospectively evaluated 100 healthy fetuses from 14 to 38 weeks' GA and calculated the mean atrial size of 7.6mm with SD of 0.6. The range for the size of atrium found in our study is similar to those reported by Seidler and Filly,[11] who retrospectively reviewed 90 healthy fetuses during the second and third trimesters and showed the range of atrial size between 4 and 8 mm.

In our study, the upper range of the size of atrium varied from the study done by Hilpert et al[7], who reported it as 11mm which was 2.1mm more as compared to the present study.

Our study also showed significant increment in the size of atrium with increasing period of gestation with a significant positive correlation with GA (r2 value of 0.78 ; $p<0.001$). This was similar to those reported by Hilpert et al[7] and Almog et al[8]. In the study conducted by Hilpert et al,[7] linear regression analysis showed that there was small but statistically significant increase in size of atrium with increasing GA(r2 value of 0.12; $p=0.0029$). Almog et al[8] also reported significant correlation between the size of atrium and GA (r2 0.38; $P < .0001$). There was a weak correlation between the size of atrium and GA in both the studies as compared to ours which could be due to larger sample size in both of these studies.

One of the major drawbacks in the present study was less number of patients of the late third trimester pregnancies. However this was also the same drawback of other studies too. Another potential weakness of the current study was the lack of clinical information of normalcy at or after delivery. However this was also a weakness of all previous studies as well.

Atrium measurement

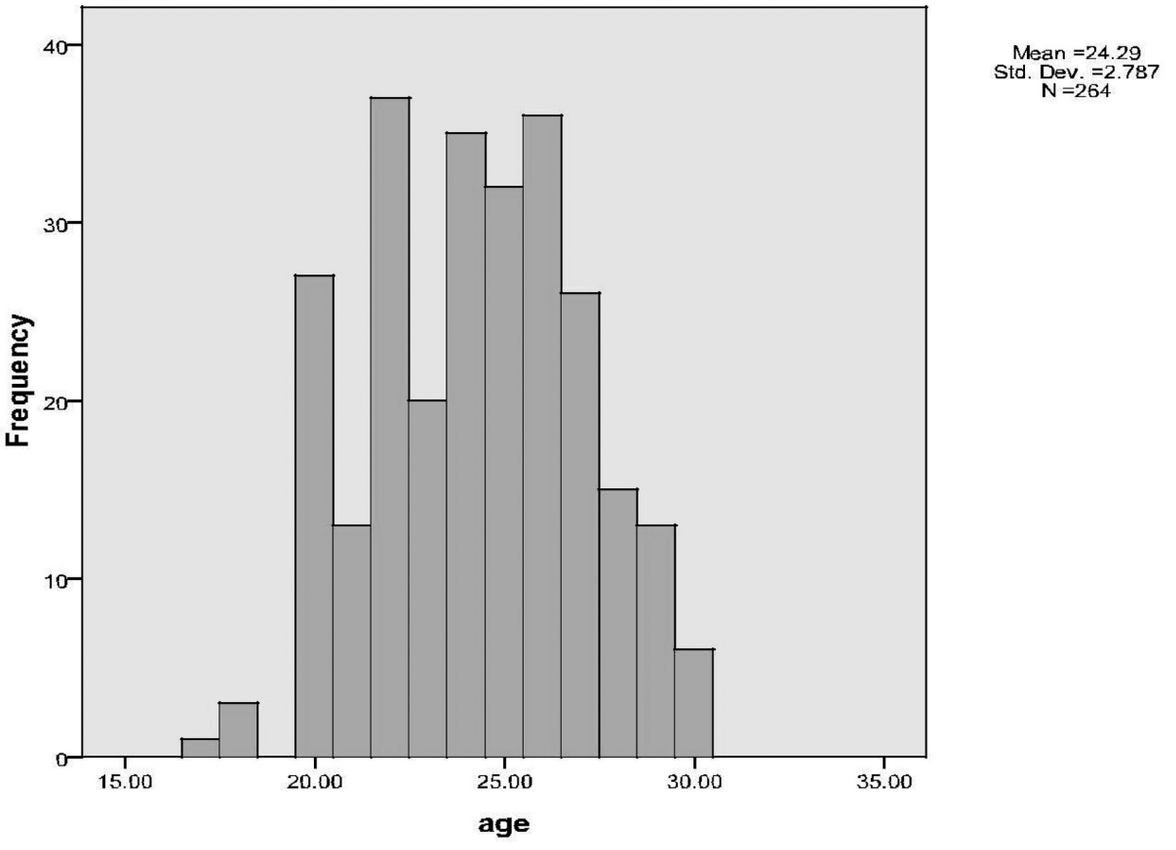

Figure 1: Distribution of patients according to age

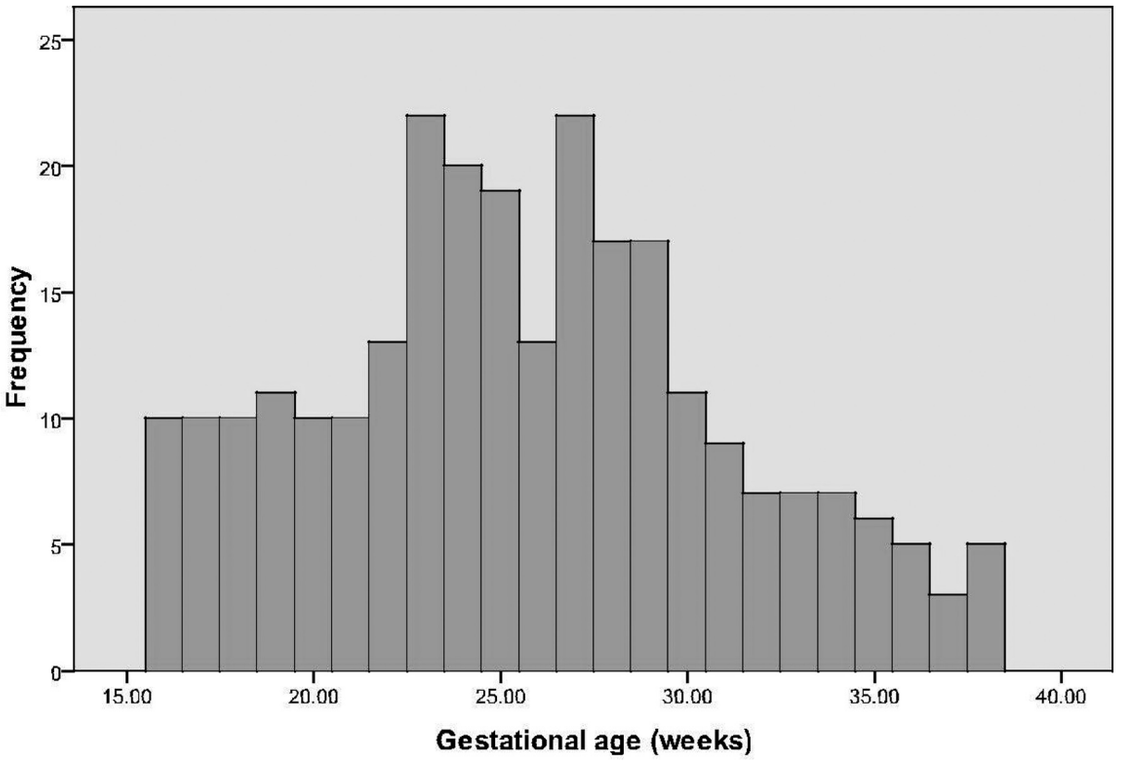

Figure 2: Distribution of patients at different GA

Table 1: Mean and standard deviation of the size of atrium at different GA

GA(weeks)	Atrium Mean(mm)	SD
16	4.36	0.87
17	5.45	1.49
18	4.86	0.54
19	4.55	0.52
20	4.52	0.62
21	5.67	0.48
22	5.70	0.43
23	5.72	0.49
24	5.88	0.44
25	5.65	0.40
26	6.66	0.39
27	6.74	0.45
28	6.75	0.43
29	7.12	0.36
30	7.36	0.21
31	7.59	0.58
32	7.63	0.51
33	7.89	0.43
34	8.04	0.58
35	7.78	0.64
36	7.98	0.76
37	7.57	0.31
38	8.18	0.46

Table 2: Percentile values (5th, 50th and 95th) of the size of atrium at different GA

GA(weeks)	Percentile		
	5th	50th	95th
16	3.5	4.1	5.6
17	3.8	5.4	7.5
18	3.9	4.75	5.6
19	3.8	4.8	5.2
20	3.6	4.6	5.4
21	5.1	5.55	6.6
22	5.1	5.7	6.4
23	5.1	5.6	6.6
24	5.2	6	6.6
25	5.1	5.7	6.4
26	6.1	6.5	7.2
27	6.1	6.7	7.4
28	6.2	6.7	7.4
29	6.1	7.2	7.5
30	7.1	7.3	7.7
31	7	7.4	8.6
32	7.2	7.4	8.5
33	7.3	7.8	8.5
34	7.2	8.1	8.9
35	7.1	7.6	8.7
36	7.1	7.9	8.8
37	7.3	7.5	7.9
38	7.4	8.3	8.6

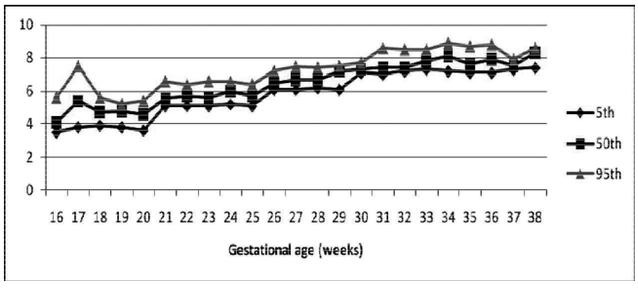

Figure 3: Diagram of the size of atrium against GA with 5th, 50th and 95th percentile lines.

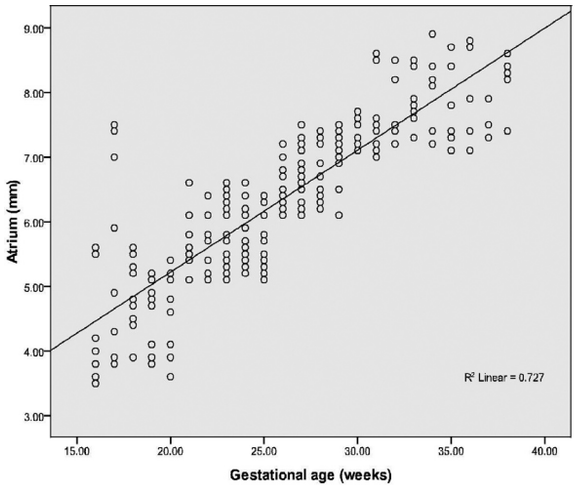

Figure 4: The scattered diagram showing the size of atrium against GA.

Table 3: Correlation of the size of atrium and CM with GA

Parameters	Pearson Correlation (r) with GA	p value
Size of atrium	0.372	<0.001

Conclusion

All the practicing radiologists and sonologists should pay special attention to fetal lateral ventricle during the second and third trimester prenatal sonographic study because ventriculomegaly is one of the most sensitive indicator of anomalous development of the fetal brain and spinal cord. If any abnormal measurement is obtained, a careful sonographic examination of the entire fetus and further investigations like maternal serum alfa fetoprotein, fetal karyotyping, fetal echocardiography as well as proper counseling to the parents are necessary. The reference value of the size of atrium of lateral ventricle calculated from our study can be used as a baseline data for comparison with borderline measurements of atrium.

Continuous increment in the size of atrium with increasing GA found in our study is consistent with the previous studies done by various authors.

The percentile fitted values and nomograms will be valuable for the serial measurement of atrium of lateral ventricle in complicated pregnancies.

However, before clinical application of our results, study involving large sample size is required.

Conflict of interest: None declared

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