Original Article

Sonographic measurement of the size of fetal cisterna magna 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 determine the normal size values of fetal cistern magna(CM) and to evaluate its changes in normal fetuses in low risk population of pregnant women in the second and third trimesters of pregnancy using transabdominal ultrasonography.

Methods: This was a prospective cross-sectional study involving 290 women with uncomplicated singleton gestation between 16-38 weeks. CM was visualized in 264 cases. Gestational age was calculated by measuring fetal biparietal diameter (BPD). CM was measured from the posterior aspect of the cerebellar vermis to the inner edge of occipital bone. Nomogram of the sizes of CM was prepared.

Results: CM 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 CM was 6.32mm, (SD1.09; range 3- 9 mm).

Conclusion: The size of fetal CM showed continuous increment and showed significant positive correlation with the gestational age(r2 value of 0.48; p<0.001). 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 CM for complicated pregnancies.

Keywords: cisterma magna, ultrasonography, vermis.

Introduction

The cisterna magna (or cerebellomedullary cistern) is the largest cistern. Cisterns are CSF filled subarachnoid spaces where the pia and arachnoid mater are not in close approximation. The cisterna magna is located between the cerebellum and the dorsal surface of the medulla oblongata. Cerebrospinal fluid produced in the fourth ventricle drains into the cisterna magna via two lateral apertures(foramen of Luschka) and one median aperture(foramen of Magendie).[1]

Since many congenital posterior fossa lesions alter the size of the cistern magna, evaluation of the fetal cistenna magna is of paramount importance in assessing infratentonial anatomy and pathology. CM can easily be delineated during antennal sonography as a fluid filled structure arching around the posterior aspect of cerebellum. Although smaller in adults, it may be proportionally large in neonates, even in the absence of infratentonal pathology.[2] Mega cisterna magna is another benign variant of normal. [3]

Enlarged CM may be secondary to a Dandy-Walker malformation, which is characterized by a midline cyst within the posterior fossa that communicates with the fourth ventricle and agenesis or hypoplasia of the crebellar vermis.[4]

An enlarged cisterna magna in the presence of a Dandy-Walker malformation has also been associated with chromosomal abnormalities such as trisomy 13, 18 and 21. [5,6]

Although an enlarged cisterna magna as part of the Dandy-Walker malformation is associated with poor outcomes, the clinical outcomes of an isolated mildly enlarged cisterna magna, in the absence of other congenital, chromosomal, or structural abnormalities is associated with normal outcomes.[7] Small and effaced CM is associated with meningomyeloceles and chiari II malformations.[8] A normally appearing CM virtually excludes the possibility of open myelomeningocele. [9]

In third trimesters CM is not consistently visualized because of shadowing from well ossified occipital bone or inappropriate head position.[10] However cerebellar vermis is not fully developed at second trimester and observing at early weeks may cause to misevaluate normal appearance. Therefore, exact evaluation of cistern magna and posterior fossa should not be performed before 16-17 weeks. [11]

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 obstetric scan was done first 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. The CM was measured from the posterior aspect of cerebellar vermis to the inner edge of the occipital bone.

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 CM. 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 CM was fetal position and maternal 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 fetal CM was 4.12±0.72 at 16 weeks of gestation which increased to 7.5±0.79 at 38 weeks. (Table 1)

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

There was linear correlation between the sizes of CM 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:- CM = 2.733 + 0.140 GA ($p<0.001$); $R2 = 0.48$(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 fetal CM in our study was 6.32 mm (SD,1.09 ; range, 3-9 mm). This was similar to those reported by Filly et al [10, 3] and Serhatlioglu et al.[8] In one study, Filly et al [10] reported the mean size of CM 6.2 ± 2.0 mm (range, 3–13 mm). In another study Filly et al measured the size of the CM, which ranged between 2 mm and 10 mm. [3] In a study done by Serhatlioglu et al [12] in 130 pregnant women, measurements of CM were similar to those two groups. However the upper range of the size of CM was lower by 2mm in our study as compared to Filly et al [10] who reported it as 11mm.

Our study also shows moderate though significant correlation between the size of CM and GA (r2 value of 0.48 ; $p<0.001$). This is similar to those reported by Serhatlioglu et al, [12] who found that the size of the CM correlated significantly with GA (r2 value 0.66; $p < 0.001$). In the study of Köktener et al [13] performed on 194 fetuses between 16–24 weeks of GA, it was found that the size of CM was in correlation mostly with GA (r2=0.75 $P<0.001$). Strong correlation between the size of CM and GA found in these studies as compared to ours may be due to smaller sample size in their studies as compared to ours.

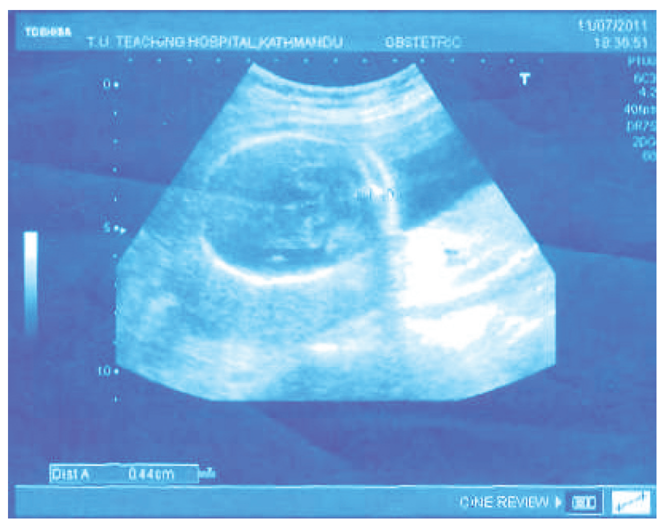
In a study done by Airsoy R, Yayla M, [14] between 15-24 weeks of gestation, it was found that there was significant correlation between the size of CM and GA (r2=0.32; $p<0.001$). The strength of correlation between the size of CM and GA in this study was similar to our study. Our study also differs from the study done by Peter W. Callen [15], who found that there was no significant correlation between the size of CM and GA.(r2 0.04, $p>0.5$)

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.

Conclusion

Since CM is used as a soft tissue marker for congenital CNS and chromosomal abnormalities, it should be examined carefully during second and third trimester antenatal sonogram. 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 CM calculated from our study can be used as a baseline data for comparison with borderline measurements of atrium.

Continuous increment in the size of CM 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 CM in complicated pregnancies. However, before clinical application of our results, study involving large sample size is required.



CM measurement

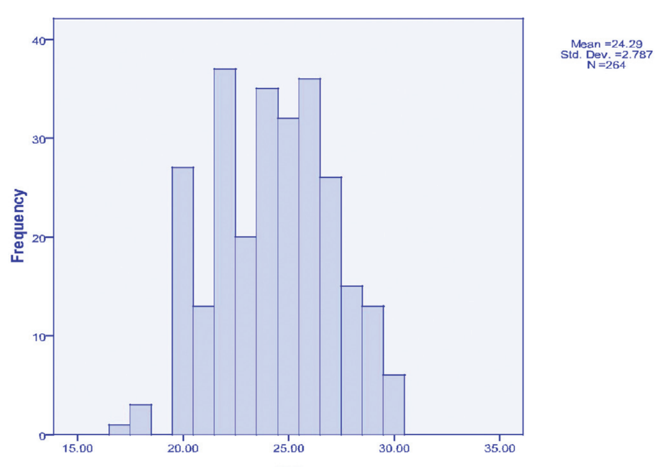


Figure 1: Distribution of patients according to age

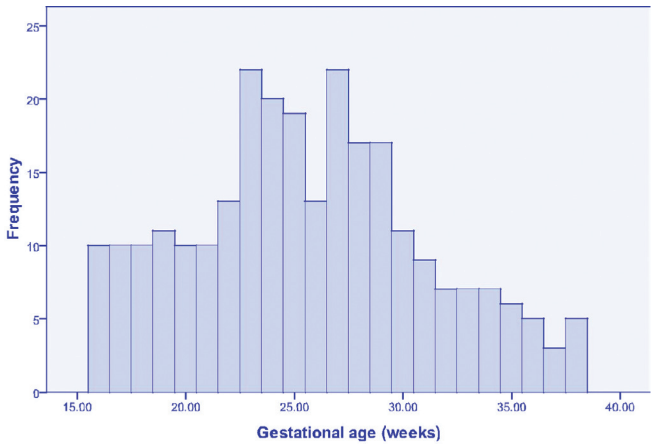


Figure 2: Distribution of patients at different GA

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

GA(weeks)	CM	
	Mean(mm)	SD
16	4.12	0.72
17	5.18	1.23
18	5.22	0.54
19	4.84	0.87
20	5.02	0.87
21	6.25	0.82
22	6.13	0.68
23	6.15	0.45
24	6.18	0.59
25	6.04	0.44
26	6.72	0.88
27	6.93	0.67
28	6.88	0.57
29	7.06	0.75
30	7.10	0.86
31	6.84	1.02
32	6.69	0.61
33	7.00	0.72
34	7.10	0.42
35	7.13	0.56
36	7.62	1.07
37	8.03	1.08
38	7.50	0.79

Mean size of CM was 4.12±0.72 at 16 weeks of gestation which increased to 7.50±0.79 at 38 weeks.

Table 2: Percentile values (5^{th}, 50^{th} and 95^{th}) of the size of CM at different GA

GA(weeks)	Percentile		
	5^{th}	50^{th}	95^{th}
16	3.5	4.05	5.5
17	4.1	4.75	7.5
18	4.4	5.25	5.9
19	3.2	4.9	5.9
20	3.4	5.1	5.9
21	4.7	6.55	7.0
22	4.2	6.4	6.8
23	5.33	6.05	6.9
24	5.0	6.25	6.9
25	5.2	5.9	6.8
26	5.1	6.9	7.6
27	5.44	7.1	7.87
28	5.6	6.9	7.8
29	5.4	7.5	7.9
30	5.4	7.5	7.9
31	5.7	6.7	9
32	5.9	6.6	7.8
33	6.4	6.7	8.5
34	6.5	7.1	7.7
35	6.5	7.0	8.1
36	6.4	7.4	9
37	6.8	8.5	8.8
38	6.7	7.5	8.6

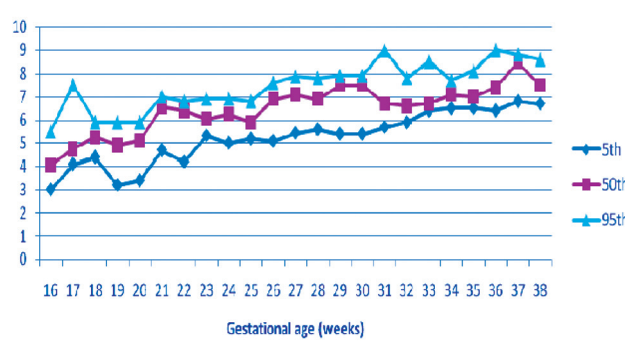


Figure 3: Diagram of the size of CM against GA with 5^{th}, 50^{th} and 95^{th} percentile lines.

There was continuous increment in the size of CM with increasing GA.

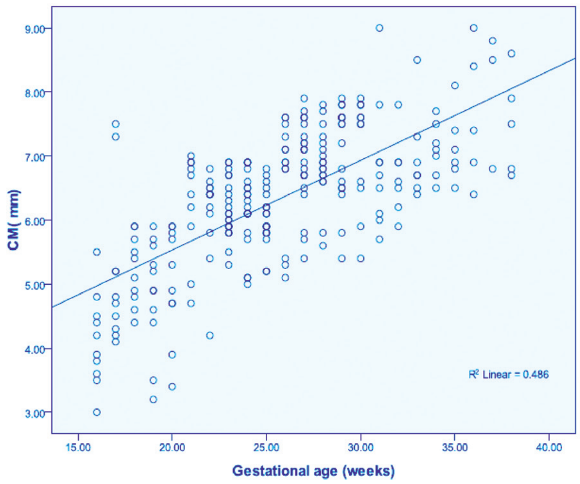


Figure 4: The scattered diagram showing the size of CM against GA.

There was linear coorelation between the size of CM and GA

Table 3: Correlation of the size of CM with GA

Parameters	Pearson Correlation (r) with GA	p value
Size of CM	0.331	<0.001

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