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Original Research Article

Transabdominal Sonographic Measurement of the Cavum Septum Pellucidum in Second and Third Trimester Fetuses: A Cross-Sectional Study

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Abstract: ***Background*:** The cavum septum pellucidum (CSP) is key midline brain structure routinely assessed in fetal neurosonography. Although CSP visualization is essential for detecting anomalies of forebrain development, normative data for CSP width across gestation remain limited, particularly in South Asian populations. ***Objective*:** To evaluate visualization rate of CSP in normal fetuses during second and third trimesters, measure CSP width using transabdominal ultrasound and determine its correlation with gestational age. ***Methods*:** A hospital-based descriptive cross-sectional study was conducted among 144 singleton pregnancies between 14–41 weeks at BPKIHS. Transabdominal ultrasonography was performed using standard axial plane at the level of thalami. CSP visualization and CSP width were recorded. Descriptive statistics, chi-square tests and Pearson correlation were applied. ***Results*:** CSP was visualized in 130 of 144 fetuses (90.3%). Visualization was optimal between 18–37 weeks, accounting for 84.6% of all visualized cases, whereas visualization before 18 weeks was limited (33.3%). CSP width ranged from 1.81 to 6.8 mm, with mean of 4.23 ± 1.12 mm. CSP width was significantly greater in third trimester than second (4.57 ± 0.95 mm vs. 3.39 ± 1.11 mm; $p < 0.001$). Gestational age showed a significant positive correlation with CSP width ($r = 0.520$, $p < 0.001$). ***Conclusion*:** CSP is reliably visualized between 18–37 weeks of gestation. CSP width increases significantly with advancing gestation and act as consistent neurosonographic marker of normal midline brain development. This study establishes normative CSP measurements for a Nepalese population and supports routine CSP assessment during mid-trimester ultrasound.

Keywords: Cavum Septum Pellucidum, Fetal Neurosonography, Ultrasonography, Gestational Age.

INTRODUCTION

The cavum septum pellucidum (CSP) is a fluid-filled midline structure located between the leaflets of the septal laminae, serving as an important anatomical and sonographic landmark in evaluating fetal brain development [1]. Its visualization during routine obstetric ultrasonography is critical, as non-visualization may indicate significant central nervous system (CNS) anomalies such as agenesis of the corpus callosum, holoprosencephaly, and septo-optic dysplasia. The CSP is typically present between 18 and 37 weeks of gestation, after which it begins to narrow physiologically [2].

Despite its diagnostic value, normative data for CSP width, particularly across the second and third trimesters, remain limited and population-specific variations are poorly understood. The absence of standardized reference ranges can result in diagnostic ambiguity, unnecessary referrals, or missed detection of midline anomalies. This underscores the need for gestational age-specific CSP measurements, especially in resource-limited settings where ultrasound is the primary imaging modality [3, 4].

This study aims to provide normative sonographic measurements of CSP width and evaluate CSP visualization patterns among normal fetuses in a Nepalese population, offering local reference standards to enhance diagnostic accuracy in fetal neurosonography.

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MATERIALS AND METHODS

A descriptive, cross-sectional, hospital-based observational study was performed in the Department of Radiodiagnosis and Imaging, BPKIHS.Pregnant women between 14–41 weeks with structurally normal singleton fetuses presenting for routine antenatal ultrasound were included. Exclusion criteria were multiple gestation, congenital anomalies (especially CNS), intrauterine growth restriction, oligohydramnios, and poor sonographic visibility.Based on a reported CSP visualization rate of 40% at 15 weeks (Falco *et al*.,) with 95% confidence and 8% margin of error, a minimum sample size of 144 was calculated [5]. Consecutive purposive sampling was used until the required sample size was achieved.Transabdominal ultrasonography was performed using a standard axial trans-thalami plane (Figure 1). CSP visualization (present/absent) and CSP width (mm) were measured using electronic calipers. Gestational age was confirmed by first-trimester scans or reliable last menstrual period. Data were analyzed using SPSS v20. Descriptive statistics summarized demographic data and CSP measurements. The chi-square test assessed associations between CSP visualization and gestational age groups. Pearson correlation evaluated the relationship between CSP width and gestational age. A p-value < 0.05 was considered statistically significant.

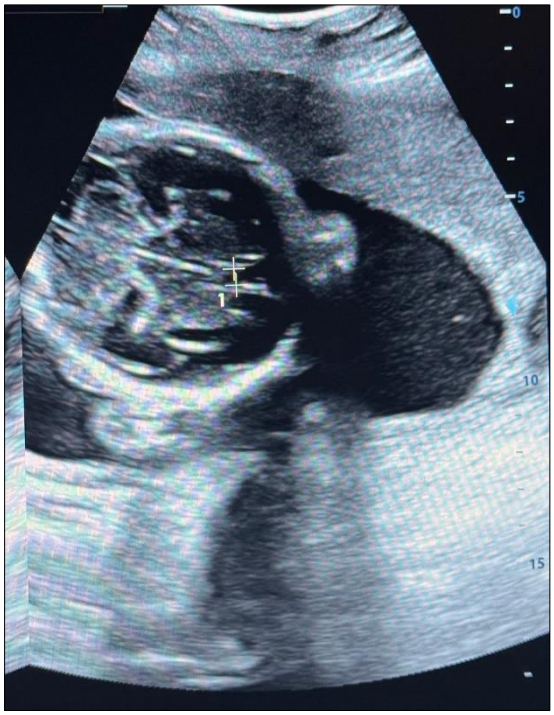

Figure 1: Transabdominal sonography showing measurement of width of Cavum Septum Pellucidum at the level of thalami

RESULTS

CSP was visualized in 130 of 144 fetuses (90.3%). Visualization was optimal between 18–37 weeks, accounting for 84.6% of all visualized cases, whereas visualization before 18 weeks was limited (33.3%). The distribution of CSP visualization according to gestational age in weeks in routine anomaly scans is shown in table 1.

Table 1: CSP visualization among different gestational age in weeks

			CSP		Total
			Visualized	Non-visualized	
Gestational age	14 to 15 weeks	Count	2	4	6
		% within CSP visualization	1.50%	28.60%	4.20%
	16 to 17 weeks	Count	1	2	3
		% within CSP visualization	0.80%	14.30%	2.10%
	18 to 37 weeks	Count	110	5	115
		% within CSP visualization	84.60%	35.70%	79.90%
	38 to 41 weeks	Count	17	3	20
		% within CSP visualization	13.10%	21.40%	13.90%
Total		**Count**	**130**	**14**	**144**

Cases where CSP was visualized had a much higher mean gestational age compared to cases where it was not visualized and the finding was statistically significant as shown in Table 2.

Table 2: Comparison of CSP Visualization with Gestational Age:

Variable	Visualized			Non visualized			P-value
	Mean	SD	SEM*	Mean	SD	SEM*	
Gestational age weeks	30.46	6.562	0.576	23.29	10.469	2.798	<0.001

SEM*: Standard error of mean

Among 130 visualized cases, the mean value of the CSP width was found to be 4.23 ± 1.12 mm with maximum value observed as 6.8 mm and minimum value as 1.81mm. Gestational age showed strong Positive Correlation with CSP Width which was statistically significant (r =0.520, p < 0.001). Therefore as gestational age increases, the CSP width significantly increases as shown in table 3.

Table 3: Correlations of Gestational Age with CSP Width

Variables	Statistics	CSP width(mm)
Gestational age in weeks	Pearson Correlation	0.520**
	Sig. (2-tailed)	<0.001
	N	130

DISCUSSION

The cavum septum pellucidum (CSP) is a fluid-filled midline structure located in the fetal brain between the two leaflets of the septum pellucidum. It serves as an important sonographic landmark in obstetric ultrasound, as its presence is closely linked to normal forebrain development [1]. The evaluation of the CSP is a critical component of the mid-trimester anomaly scan (18-22 weeks), where its absence may indicate severe central nervous system (CNS) malformations, such as agenesis of the corpus callosum (ACC), holoprosencephaly, or septo-optic dysplasia [2].

In this study, the cavum septum pellucidum (CSP) was visualized in 90.3% of normal fetuses between 14 and 41 weeks of gestation, with optimal visualization rates observed between 18 and 37 weeks (84.6%). The CSP width was significantly greater in the third trimester compared to the second trimester (4.57 ± 0.95 mm vs. 3.39 ± 1.11 mm; $p < 0.001$), and a strong positive correlation was noted between gestational age and CSP width (r = 0.520, $p < 0.001$). These findings are consistent with previously published data and support the inclusion of CSP assessment in routine obstetric neurosonography, particularly during the mid-trimester anomaly scan.

Falco *et al*., (2000) reported that CSP was clearly identified in 100% of fetuses between 18 and 37 weeks using transabdominal ultrasound, reinforcing the reliability of CSP visualization in this gestational window. Their reported mean CSP widths also demonstrated a progressive increase with advancing gestation: 3.3 ± 0.9 mm at 19-23 weeks, 4.7 ± 0.9 mm at 30- 34 weeks, and 4.9 ± 0.8 mm at 35-38 weeks.5 These findings are in close agreement with the current study, where the mean width increased from 3.39 mm in the second trimester to 4.57 mm in the third trimester.

Several other studies have similarly demonstrated the age-dependent visualization and growth of the CSP. Serhatlioglu *et al*., (2003) reported consistent visualization of the CSP in fetuses between 19 and 37 weeks, with a gradual increase in width paralleling gestational age [6]. Tao *et al*., (2013) described the sonographic appearance of the CSP et vergae in normal fetuses and confirmed its development and enlargement during the second and third trimesters [7].

The present findings also align with Arisoy *et al*., (2022), who provided a nomogram for CSP width during the second trimester, documenting a continuous increase with gestation [8]. Similarly, Bayraktar and Taner (2019) proposed a fetal CSP nomogram and highlighted the need for ethnicity-specific standards. Their results support the assertion that increasing CSP width correlates significantly with gestational age in healthy pregnancies [9].

In the current study, CSP visualization was limited in early gestation. Among fetuses between 14 and 17 weeks, the visualization rate was only 21.4%, which is consistent with the study by Jackson *et al*., (2007) in which they observed that CSP may not be reliably visualized before 18 weeks of gestation due to delayed formation of the septal laminae [10].

These findings further reinforce the recommendation that routine CSP evaluation should be performed during the mid-trimester anomaly scan (18-22 weeks), when its visualization is most consistent. Importantly, the current study found no significant correlation between maternal age and CSP width, indicating that CSP development is primarily dependent on fetal gestational maturity rather than maternal demographic variables.

CONCLUSION

CSP visualization is reliable between 18–37 weeks of gestation. CSP width increases significantly with gestational age, making it a useful neurosonographic marker in evaluating fetal midline brain development. The normative CSP measurements established in this study can serve as a reference for routine obstetric ultrasound in Nepal.

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