

Infant Neurosonographic Study of Lateral Ventricular Asymmetry

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Abstract

The normal human body is known to exhibit bilateral asymmetry in many of its structures. The brain is not an exception to this general rule. Literature search shows many studies done on the asymmetric pattern of the lateral ventricles but, there is dearth of similar information in the Indian population. This study was thus planned to prove the asymmetry of lateral ventricles in term born infants in Indian population. It was conducted in a tertiary care hospital on 101 term born infants. The width of the lateral ventricles and the cerebral hemispheres were measured by performing neurosonography through the anterior fontanelle. The mean and the standard deviation were calculated. The unpaired 't' test was applied and the probability value was determined. The study proved that there was no bilateral asymmetry seen in the ventricular measurements of the term born infants.

Key words: Neurosonography, Lateral ventricular width, Hemispheric width, Anterior fontanelle, Bilateral asymmetry

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Introduction

The human brain is considered as the most functional and well organized matter of the universe. The unique feature of this organ is its continuously changing and developing structure. These changes are maximally seen in the first few years of the postnatal life. During this period, the growth and maturation of the brain are at its maximum pace and both microscopic as well as the macroscopic morphology of the brain is seen to be changing¹. The studies have also shown that at birth, the volume of the brain is approximately 25% of its volume in adult life and by the end of the first year, the same volume increases to 75% of its adult volume.² Thus, the period of infancy (i.e. From birth up to one year of age) is considered as an important period as a small insult at this stage could subsequently lead into a devastating adulthood. But, fortunately, the study of brain in this crucial phase is made easy because of the presence of fontanelles. The fontanelles serve as a normal acoustic window to perform ultrasonography of brain. Neurosonography via anterior fontanelle of an infant brain is known to be a safe and non-invasive approach to study brain when compared with other radioimaging modalities. In addition, the introduction of the high resolution real-time ultrasound has revolutionized the intracranial diagnosis in an infant³.

Literature search on the 'neurosonographic study of brain' showed that asymmetry of the lateral ventricle

existed in all brains from fetuses to adult brains. Its presence alone is probably considered as non-significant and normal variant, rather than a pathologic finding. There are many studies proving the incidence of right ventricle being larger (Shapiro et al)⁴ whereas some stating a greater incidence of a larger left lateral ventricle (Achiron et al)⁵. Literature search showed dearth of similar studies in the Indian population. Hence, the present study was planned with an aim of proving the difference in the measurements of lateral ventricular and hemispheric width of both sides of the brain.

Materials and Methods

A prospective study was conducted in one of the Mumbai's medical teaching institutes and tertiary care centres. The study was done in collaboration with the Department of Radiology. The Ethics committee permission was obtained prior to the commencement of the study.

One hundred and one term born infants referred for sonography of other regions i.e. without any intracranial pathology were randomly selected. The informed consent was taken from the parents/ guardians of the infants after explaining the study procedure and purpose. The name, gender and address of the infants were documented as an identity mark. The birth history and the gestational age of the infants were documented from the birth record form. In cases where there was no past record available, the history at the time of the birth of the baby was enquired from the parents to know the general medical status of the infants. Lastly, the purpose of the referral of the neonate to the Radiology department i.e. the part for which sonography was asked for and noted.

Neurosonography was then performed in a warm environment when the infant was quiet or after feeding. There was no preparation of the infant required prior to

the commencement of the procedure. The head was exposed and the baby was placed in supine position with the head end towards the sonologist. In certain cases, the head was stabilized by holding it gently by the sides (Fig. 1). The anterior fontanelle was selected as an acoustic window for scanning the brain. This fontanelle provided an imaging port for adequate penetration and delineation of the brain and ventricles. Imaging was done using an ATL (HDI 3000) machine with phased array sector transducers of 5-9 MHz through soluble coupling agent. During scanning, both coronal and sagittal scans were made to visualize the entire ventricular system. The structures containing CSF such as the ventricles, cisterns and the subarachnoid space appeared anechoic while the normal brain tissue generated low to mid-level echoes.

The measurements were done on inclining the transducer 10-20° anterior to the mid-coronal plane i.e. CP 3 or coronal plane 3. The anterior horns of the ventricles were visualized in this section. In the coronal view they appeared as thin, sonolucent, symmetric structures on either side of the midline. The lateral ventricular width (LVW) was measured as the maximum distance between the most lateral extent of the ventricle and the falx. The hemispheric width (HW) was also taken at the same level as the maximum distance between the falx and the inner table of the calvaria. The measurements of right and left side were taken separately (Fig. 2). All these dimensions were taken in millimeters. After the entire scanning of the brain the diagnosis made on sonography was recorded. The required images were saved on the machine. These were later transferred on a CD and a soft copy was made.

The mean and the standard deviation was first calculated and compared with the other similar studies. The other statistical test applied was the student's unpaired t-test.

The unpaired t test was calculated by the following

$$\pm t = \frac{\bar{\chi}_1 - \bar{\chi}_2}{\text{Sd}}$$

Where, $\bar{\chi}_1$ is the mean of the left side and $\bar{\chi}_2$ is the mean of the right side while Sd is Standard error of means. Here, the degrees of freedom were first calculated for estimating the table 't' value.

In both the above statistical tests, the probability i.e. 'p' value was calculated to estimate the significance level of the test. Ideally, for statistical purposes a 'p' value of >0.05 is considered as the significant one while a value of p<0.05 is insignificant. Both these tests were appropriately applied and graphically represented wherever required.

Results and Discussion

In the present study, the one hundred and one (101) term born infants were grouped on the basis of their gender into two groups; one comprising of 69 male infants and the other of 32 female infants. The mean,

standard deviation, 't' value and the probability 'p' value was calculated in both groups for the right and left ventricular and hemispheric sizes (Table 1). The 't' value was calculated to be 0.84 and 0.92 for the right and left ventricular width in term males and females respectively. The right and left hemispheric sizes showed the 't' value of 0.89 and 0.98 in term males and females respectively. The calculated 't' value when compared with the table 't' value was smaller i.e. p>0.05 indicating that there is no statistical significance in the comparison done. Thus, the null hypothesis which was stated in the objective i.e. there is no bilateral asymmetry in the lateral ventricular and hemispheric measurements in term born infants was proved.

The lateral ventricular asymmetry is a normal finding and considered as a normal variant unless proved otherwise. Shen and Huang had shown a prevalence of 16.9% to 37.9% for this asymmetry⁶. The asymmetry of a human brain can attributed to the lateralization of the brain⁷. In the present study, with the aim of proving the same, neurosonography via anterior fontanelle was performed on 101 term born infants. During the process, it was possible to measure only the anterior horns of lateral ventricles whereas the measurements of the body and the occipital horns of lateral ventricles were unfeasible and thus they were spared from the measurements. It was not possible to assess and measure these structures because of the possible errors caused by transducer obliquity while scanning these regions. A similar explanation was given by Winchester et al⁸ in their study on 53 infants. Also, (Sonmee cha)⁹ have showed that frontal horn asymmetry is one of the common normal findings while bilaterally comparing the different parts of the lateral ventricles. The author describes many postulates correlating this asymmetry to age, handedness etc but concludes by mentioning, that the mechanism behind the asymmetry remains conjectural and the range of asymmetry too remains unknown. Thus, in the present study, only the width of the anterior horns of the lateral ventricles and the corresponding hemispheric width were measured and noted. After analyzing it was proved that, even though there was an apparent difference seen in the measurements obtained, statistically, there was no significant difference seen in the bilateral lateral ventricular width and hemispheric width. The apparent difference seen in the sizes of the anterior horn of the lateral ventricles could be attributed to the observer's variability in taking the measurements. Also the sample size could have played a role in proving the postulates of this study as the statistical insignificant. A similar finding was reported by Lodin¹⁰ through his study on 119 encephalographies that there is no notable difference in the width between the lateral ventricles in the 1-year group. He also proved that the left ventricle was somewhat wider than the right one. A similar finding of the wider left ventricle was also noted by Ischihashi et al¹¹. They had attributed the difference seen to the head

position of the infant at the time of sonography. The explanation given by them for the ventricular asymmetry was not pathological, but was due to the individual differences. The ventricular asymmetry seen is also attributed to the distorted or compressed lateral ventricles seen by Winchester et al. The differentiation in such cases is difficult and would require a 3-D study or

other investigation to diagnose existence of such an entity.

To conclude, there was no lateral ventricular asymmetry seen in the present study. The study needs to be continued further so as to increase the sample size and needs to be performed by a same sonologist to avoid observer variability affecting the results.

Table 1: Comparison of the right and left sonographic measurements in the two groups

Category	Test	Rt LVW	Lt LVW	Rt HW	Lt HW
Term males (n=69)	Mean	14.0	14.18	49.1	49.3
	SD	2.21	2.22	6.01	6.02
	t test	0.847		0.893	
	P value	>0.05			
Term females (n=32)	Mean	14.4	14.5	50.2	50.2
	SD	1.72	1.80	4.94	4.96
	t test	0.926		0.988	
	P value	>0.05			

(Rt LVW: Right Lateral Ventricular Width, Lt LVW: Left Lateral Ventricular Width, Rt HW: Righthemispheric Width and Lt HW: Left hemispheric Width)



Fig. 1: Neurosonography via anterior fontanelle



Fig. 2: Measurements of the left lateral ventricular width (Lt LVW), right lateral ventricular width (Rt LVW), left hemispheric width (Lt HW) and right hemispheric width (Rt HW)

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