CRANIAL SONOGRAPHY IN PRETERM INFANTS

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ABSTRACT

Fifty preterm newborn infants with gestational age of 28-36 weeks were subjected to real time cranial sonography to (a) evaluate the ventricular system and brain parenchyma, (b) determine the incidence of intracranial abnormalities, and (c) to establish the utility and advantages of routine cranial sonography in preterm infants. The lateral ventricular width varied from 6-12 mm (8.67 ± 1.85 mm) while hemispheric width ranged between 3.68 to 3.95 cm with a mean of 3.84 ± 0.25 cm. The lateral ventricular ratio ranged from 20.9 to 26.4% and it showed progressive decrease with increasing gestational age. Cavum septum pellucidum was found in 68% of the preterms. Incidental intracranial pathologies were detected in 12% of the preterms screened.

Key words: *Cranial sonography, Preterms.*

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Diagnostic modalities like angiography, ventriculography and pneumoencephalography ushered in a new era of neuroradiology. However, the inherent hazards of these invasive procedures make their routine use impossible for the delicate neonatal brain. Introduction of computed tomography and sonography gave a new hope to the pediatric radiologist. Computed tomography (CT) is expensive, time consuming, has radiation hazards and requires transportation of the neonate to the CT room which may not have the secure environment required for the newborn. The ease, convenience and safety of ultrasound with increasing sensitivity of newer equipment has helped it in replacing CT as the modality of choice for preterm cranial evaluation.

Material and Methods

The present studty comprised of 50 newborns with gestational age of less than completed 37 weeks. Prematurity was assessed by the last menstrual period and clinical assessment using Ballard's scoring method(1). Whenever there was discrepancy of more than 2 weeks between the two, the gestational age measured by the latter was taken to be the right age.

All preterms were subjected to detailed clinical assessment and different anthropometric parameters were recorded. The infants were scanned on phillips SDU 3000 real time sector scanner using 5 MHz short focus transducer, using anterior fontanelle as the acoustic window. The sagittal, parasagittal and coronal scans at different levels were made to evaluate brain

parenchyma and ventricular system in detail. During the process following measurements were made: (*a*) Lateral ventricular width (LVW)–measured at the level of frontal horns of lateral ventricle as the maximum distance between the most lateral extent of the ventricle and the falx; and (*b*) Hemispheric width (HW)–this measurement was also taken at the same level, as the maximum distance between the falx and the inner table of the calvaria. Lateral ventricular ratio was calculated using these two parameters.

The clinical and sonographic datas were recorded and analyzed. The two cases one of posterior fossa bleed and other of corpus callosum agenesis were subjected to computed tomography to corroborate the sonographic diagnosis.

Results

Fifty preterm newborns with gestational age between 28-36 weeks formed the study group, of which 29 (58%) were males and 21 (42%) females. The maximum number of newborns 30 (60%) were between 33-36 weeks of gestation, only 7 (14%) ranged between 28-30 weeks.

Sonograms revealed the lateral ventricular width (LVW) ranged from 0.6 cm to 1.2 cm in normal preterm with a mean of 8.67 ± 1.85 mm. The hemispheric width (HW) varied from 3.15-4.2 cm (mean 3.84 ± 0.25) and showed a progressive increase from 28 to 36 weeks (*Table I*). It is clearly evident from *Table II* that lateral ventricular ratio (LVR) ranged from 16-24% with a clear decreasing pattern with increasing gestation. The only case of hydrocephalus due to Arnold Chiarri malformation (ACM) had LVR of 45% and LVW of 1.9 cm.

Cavum septum pellucidum (CSP) could be demonstrated sonographically in 34 to 50 neonates (68%). All the preterms with gestational age of less than 30 weeks had CSP and the percentage of infants having CSP progressively decreased with increasing gestational age.

A large percentage of newborns in 28-30 weeks group had highly echogenic cerebellum. The echogenicity gradually decreased with increase in gestational age.

TABLE I–*Hemispheric Width (HW) in Different Gestational Groups*

Gestation (weeks)	Range (cm)	Mean ± SD (cm)
28-30	3.15-4.2	3.68 ± 0.33
31-32	3.45-4.1	3.71 ± 0.24
33-34	3.70-4.1	3.93 ± 0.12
35-36	3.55-4.2	3.95 ± 0.20

Correlation Between Sonographic and Anthropometric Measuremens

The present study did not reveal any statistically significant correlation between weight of the newborn and the LVW or HW. However, the study did reveal a significant correlation between LVW and length of the newborn in age group of 31-32 and 33-34 weeks.

Table III shows the correlation between the LVW and HW was statistically significant in total population as well as in separate age groups except in preterm neonates of 28-30 weeks of gestation.

A significant correlation was observed between HC and LVW in the total population, in 28-30 weeks and 35-36 weeks gestational age group, while it was approaching significance in the other two groups (*Table IV*).

TABLE II—*Lateral Ventricular Ratio in Different Gestational Age Groups*

Gestation (weeks)	Range	Mean ± SD	Ratio in %
28-30	0.23-0.30	0.264 ±0.020	26.42 ±2.25
31-32	0.19-0.29	0.226 ±0.023	22.61 ±2.61
33-34	0.17-0.28	0.214 ±0.029	21.46 ±2.91
35-36	0.16-0.45	0.209 ±0.065	20.90 ±6.50

TABLE III—*Correlation Between LVW and HW in Different Gestational Age Groups*

Gestation (weeks)	LVW in cm Mean ± SD	HW in cm Mean ± SD	r value	p value
28-30	1.00 ± 0.11	3.68 ± 0.33	0.48	NS
31-32	0.80 ± 0.09	3.71 ± 0.24	0.55	0.05
33-34	0.88 ± 0.11	3.93 ± 0.12	0.73	0.01
35-36	0.87 ± 0.28	3.95 ± 0.20	0.66	0.01
28-36	3.84 ± 0.25	0.87 ± 0.18	0.33	0.02

TABLE IV—*Correlation of Head Circumference (HC) with LVW in Different Gestational Age Groups*

Gestation (weeks)	LVW in cm Mean ± SD	Head Circumference in cm Mean ± SD	r value	p value
28-30	1.00 ± 0.11	28.51 ± 0.80	0.77	0.05
31-32	0.80 ± 0.09	29.29 ± 1.40	0.52	0.1 < P < 0.005
33-34	0.88 ± 0.11	30.32 ± 1.25	0.48	0.1 < P < 0.05
35-36	0.87 ± 0.28	31.10 ± 1.49	0.79	0.001
28-36	0.87 ± 0.19	30.04 ± 1.61	0.28	0.05

Abnormal Sonograms

Six of the fifty preterm neonates screened revealed intracranial pathology. Various abnormalities detected were periventricular hemorrhage in two cases and hydrocephalus due to AC malformation, agenesis of corpus callosum, posterior fossa hemorrhage and multiple cystic encephalomalacia in one case each.

Discussion

Sonographic visualisation of intracranial contents has been possible for many

years. However, the development of newer high resolution real time sector scanner coupled with increasing expertise has established the role of sonography and made the future analysis of the neonatal brain very exciting and promising. It can provide anatomical details about the brain parenchyma and ventricular system with high precision. The examination can be performed at the isolette so that thermostability of the preterm and sick neonate can be maintained.

The accuracy of the sonographic measurements is well established. The width of lateral ventricle can easily be measured in coronal scan. The mean width of the lateral ventricle in this study was 8.6 mm (range 6-12 mm) which is very much comparable with the results of Sauerberi *et al.*(2) The maximum LVW in normal preterm neonate was 12 mm which correlates well with the result of Levine (3), but does not support the findings of Fiske *et al.*(4) who had lateral ventricular size of only 1 mm in 27 of 35 preterm neonates.

The mean hemispheric width in the present study was 3.84 ± 0.25 cm. There was a definite increase in the hemispheric width with increasing gestational age. The increase in the HW from 3.68 cm (mean) at 28 weeks to 3.95 cm at 36 weeks of gestation is consistent with the rapid growth pattern of cerebral hemispheres during pregnancy which has been observed by several anatomists(5,6).

By providing an accurate method for measuring LVW and HW, cranial sonography allows determination of LVR reliably. While the LV ratio allows an early diagnosis of the dilated ventricles for a given gestational age regular assessment of LV size permits early detection of changes in the lateral ventricular growth.

As observed by Rumack *et al.*(7) earlier the present study also showed a definite decrease in the LVR with increasing gestational age. This decrease in LVR is consistent with the rapid growth of the cerebral hemispheres.

The present study clearly revealed that with increasing gestational age the percentage of the newborn having cavum pellucidum progressively declined. It corroborates with the results of Farrugia *et al.* who showed CSP in 61% of preterm infants of their series(8).

We attempted to arbitrarily grade the echogenecity of cerebellum from + to +++. The present study revealed that echogenecity decreased from +++ to + from 28 weeks to 36 weeks. The high echogenecity of the cerebellum in preterm should not be mistaken for cerebellar bleed.

Sonography detected intracranial pathology in 12% of the cases. The present study had only 3 (6%) preterms with intracranial hemorrhage which is very low as compared to the incidence of 40-60% found by various workers(9,11). However, this high incidence of ICH shown by various workers was in premature newborns of less than 32 weeks of gestation and weight of less than 1500 g, while the present study more than 60% of the preterms were above 32 weeks which may explain the low incidence of ICH in the study.

The only case of posterior fossa bleed diagnosed sonographically was confirmed by CT. Rose and Wolfson(12) opined that evaluation of the posterior fossa by sonography is difficult and several other workers(13,14) have rightly observed that care should be taken not to misinterpret highly echogenic cerebellum as cerebellar bleed. The present study shows careful screening can evaluate posterior fossa successfully.

Our study highlights and establishes the role of real time sonography in the evaluation of neonatal brain. We strongly feel neurosonography should be routinely performed in all the preterm infants to find out any intracranial hemorrhage to which this group is more susceptible and to detect any other intracranial pathology. Follow up serial scans can be easily performed with positive cases to enable the pediatrician to take appropriate therapeutic measures.

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