Research Article

Evaluation of cranial sonography indices in infants and neonates

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Abstract

Background: Current ultrasound technology allows for evaluation of neonates and infants in the intensive care nursery with virtually no risk. Noninvasive, rapid evaluation of brain in the neonate and infants with reproducible results is now feasible with real-time high-resolution cranial sonography through anterior fontanelle.

Objectives: To evaluate the role of cranial sonography in neonates and infants specially stressed on its role in detecting cerebral lesions in prematurely born infants.

Materials and Methods: This study was conducted on 653 patients. The study comprised 492 neonates and 161 infants above 1month of age. Out of the 492 neonates, 384 were premature and 108 full term. Examination was done by a 3.5- and 5-MHz sector probe.

Results: Germinal matrix hemorrhage (GMH) was the commonest abnormality (67.02%). In 199 asymptomatic premature babies, cranial sonography was abnormal in 51 (25.62%) cases. The pathologies seen were GMH and hydrocephalus.

Conclusion: Cranial sonography is a quite specific method to detect cerebral pathologies. GMH, ventricular dilatation, lesions in the parenchyma, and ventricles are easily diagnosed.

KEY WORDS: Cranial sonography, intraventricular hemorrhage, hydrocephalus, premature infant

Introduction

The most crucial phase for a child, one that has the deepest impact on his life expectancy is the neonatal period to first year of life. Infant mortality rate is thus, aptly the most important indicator of the health status of a community. The most important component of infant mortality is neonatal mortality. In India, the most common causes of neonatal mortality are prematurity and low birth weight.

Cerebral intraventricular hemorrhage is one of the principle causes of death among prematurely born infants, being found at autopsy in one-third to half or more of infants weighing less than 1,200 g at birth.[1] Papile et al.[2] reported the incidence of intraventricular hemorrhage to be 43% in infants <1,500 g in 1978. Recent reports shown a declining but still substantial incidence of about 20%–25%. The incidence of periventricular leukomalacia has been reported to range from 2.3% to 26%.[3,4]

In the late 1970s and 1980s, an analysis of multiple clinical features in infants shown to have periventricular-intraventricular hemorrhage by CT scan showed poor sensitivity, specificity, and predictive value. This finding established the need for a screening tool, which has been filled by cranial ultrasonography.[5]

Cranial sonography is valuable in the evaluation and follow-up of periventricular leukomalacia, which appears as areas of increased echogenecity in periventricular white matter, later showing cystic changes. Sonography plays a key role in the initial evaluation and monitoring of ventricular dilation in the newborn.[6]

Cranial ultra sonography offers an excellent anatomic imaging of the brain when evaluating for congenital anomalies and plays an important role in the diagnosis of inflammatory processes.[7]

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Materials and Methods

This study was carried out in the Department of Radiodiagnosis, MNR Medical College & Hospital, Sangareddy, Telangana, from July 2010 to May 2015. The patients selected for the study include those neonates who were delivered in Medical College Hospital.

A real-time cranial sonography was performed on 653 patients. The study comprised 492 neonates and 161 infants above 1 month of age. Out of the 492 neonates, 384 were premature and 108 full term. The cut off value of gestational age for prematurity was taken as 37 weeks or less. Babies with birth weight less than 2,500 g were termed low birth weight, those less than 1,500 g were termed very low birth weight. Premature babies were examined as early as possible and scanning was repeated on the 7th and 21st days of the first scan or on development or deterioration of symptoms.

Examination was done by a 3.5- and 5-MHz sector probe. Open anterior and posterior fontanelle were used as windows for ultrasound scanning. Recordings were done on gray scale imaging.

The interpretation of cranial ultrasound was done under the following:

1. Size, shape, and echogenicity of ventricles
2. Periventricular area
3. Ventricular mass/heart weight (LV/HW) ratio
4. Falx cerebri, midline structures, and shift thereof
5. Status of the chroid plexus
6. Echogenicity of cerebral parenchyma
7. Sylvian fissure, cingulate, and hippocampal gyri
8. Any abnormal hyper or hypoechoic area
9. Any mass lesions

Results

In this study, 199 out of 384 premature infants were asymptomatic. The remaining 185 prematurely delivered babies had symptoms of pallor, tachycardia, tachypnea, refusal to take feeds, bulging fontanelle, hypotonia, convulsions, and decerebrate rigidity [Tables 1 and 2].

More than one symptom was present at a time in one patient. The most common symptom associated with an abnormal scan in premature babies was hypotonia; closely followed by pallor and tachycardia. The least common was decerebrate rigidity.

Germinal matrix hemorrhage (GMH) was the commonest abnormality (67.02%) found in premature babies. The other abnormalities found were hydrocephalus and periventricular leukomalacia. Hydrocephalus was a common accompaniment of intraventricular hemorrhage [Table 4].

In 199 asymptomatic premature babies, cranial sonography was abnormal in 51 (25.62%) cases. The pathologies seen were GMH and hydrocephalus [Table 5].

Majority of these patients showed hydrocephalus. The other detected abnormalities were porencephalic cysts, hydranencephaly, and a mass lesion. No abnormality was found in seven patients.

Convulsions were the most common neurological feature for the request of a cranial sonography in the 161 infants above 1 month of age in the study group [Tables 8 and 9].

Echogenic Sulci with ventriculitis with/without hydrocephalus were most commonly found in these patients. Other abnormalities were cerebritis, cerebral abscess, and lesions.

Discussion

Transfontanelle cranial sonography has an important place in the evaluation of the neurological status of neonates and infants whether symptomatic or asymptomatic.

A total of 653 patients were subjected to cranial sonography, out of which 384 were premature. The commonest symptom among the symptomatic premature babies was hypotonia. These findings are according to the study of Mercuri et al. who evaluated cranial sonography and neurological examination in a cohort of infants. They found that out of 43 patients showing deviant neurological pattern, 25 had an abnormal tone.[8] In our study, the commonest finding in premature babies was GMH. This is consistent with the findings of Sima et al who found that out of 170 positive cranial ultrasound scans in premature infants, intracranial hemorrhage was detected in 150 patients.[9] This is also supported by Allan et al in their review article on neonatal cerebral pathology diagnosed by ultrasound. Kirks et al also found a high incidence (44%) of intracranial hemorrhage in premature neonates[10] [Tables 3 and 7].

Vohr and Ment in an article on intraventricular hemorrhage in preterm infants suggested that Intraventricular hemorrhage (IVH) is a common finding and the incidence of IVH ranges from 40% to 60%.[11] Our study also revealed that the incidence of GMH fell as more and more babies reached full term. The incidence of GMH in full term infants in our study was 12.97% as against the high incidence of 67.02% in premature infants. These findings are similar to the ones noted by Perry et al who observed that there was a reduction in the incidence of cerebroventricular hemorrhage with increasing gestation[12] [Table 6].

Hydrocephalus was a common accompaniment of intraventricular hemorrhage in this study. This is in accordance with various studies on subependymal and intraventricular hemorrhage, most of which mention an association of hydrocephalus with subependymal or intraventricular hemorrhage.[1,13–15]

In this study, 25.62% premature infants had GMH without manifestating any signs thereof. This means that the usage of clinical criteria to screen infants for GMH would lead to underdiagnosis. This finding is supported by the study by Paul et al who applied clinical screening criteria for detection of IVH. They found that these criteria had a sensitivity of 51%, a specificity of 62%, and a positive predictive value of only 31%.

Table 1: Distribution of cases according to age

Age range	No. of cases	Percentage
Neonates (less than 37 weeks)	384	58.80%
Neonates (full term)	108	16.54%
Infants (above 1 month of age)	161	24.66%

Table 2: Distribution of premature infants according to symptoms

	No. of cases	Percentage
Asymptomatic	199	51.82%
Symptomatic	185	48.18%

Table 3: Symptomatology in premature neonates

Symptom	No. of cases	Percentage
Hypotonia	123	66.48%
Pallor	107	57.83%
Tachycardia	96	51.89%
Tachypnea	84	45.40%
Refusal to take feeds	72	38.91%
Bulging Fontanelle	65	35.13%
Convulsions	96	51.89%
Decerebrate rigidity	43	23.24%

Table 4: Range of sonographic abnormalities in symptomatic premature babies

Sonographic abnormality	No. of cases	Percentage
Germinal matrix hemorrhage	124	67.02%
Hydrocephalus	69	37.29%
Periventricular leukomalacia	44	23.78%

Table 5: Sonographic findings in asymptomatic premature babies

Sonographic finding	No. of cases	Percentage
Germinal matrix hemorrhage and/or hydrocephalus	51	25.63%
Normal sonogram	148	74.37%

Table 6: Range of clinical features in 108 full term neonates

Symptom	No. of cases	Percentage
Bulging fontanelle	82	75.92%
Hypotonia	66	61.11%
Neurological deficit	57	52.77%
Pallor	53	49.07%
Convulsions	24	22.22%

Table 7: Sonographic abnormalities in 108 full term neonates

Sonographic abnormality	No. of cases	Percentage
Hydrocephalus	74	68.51%
Germinal matrix hemorrhage	14	12.97%
Porencephaly	10	9.25%
Cystic encephalomalacia	8	7.40%
Hydranencephaly	2	1.86%
Mass lesion	1	0.93%
Normal	7	6.48%

Table 8: Clinical features in 161 infants above 1 month of age

Symptom	No. of cases	Percentage
Fever	131	81.36%
Convulsions	112	69.56%
Neurological deficit	73	45.34%
Refusal to take feeds	72	44.72%
Hypotonia	58	36.02%

Table 9: Sonographic abnormalities in 161 infants

Sonographic abnormality	No. of cases	Percentage
Echogenic Sulci	67	41.61%
Hydrocephalus	64	39.75%
Cerebritis	22	13.66%
Cerebral abscess	6	3.72%
Mass lesions	4	2.48%
Normal	62	38.50%

They noted that selective screening using clinical risk factors would have missed 49% cases of IVH including 46% grade III and IV hemorrhage.[16] The most common neurological complaint in which a cranial sonography was requested in the 161 infants above 1 month of age in this study was convulsions. The most common symptom, however, was fever.

Conclusion

Cranial sonography is a sensitive and specific method to detect cerebral pathologies. GMH, ventricular dilation, and lesions in the parenchyma and ventricles are easily diagnosed. GMH is the most common lesion detected in prematurely born infants. Hypotonia is the most common manifestation of GMH. A large number of premature infants with subependymal or intraventricular hemorrhage are asymptomatic. Allocation of premature infants for cranial sonography on the basis of clinical criteria would miss a substantial number of patients with intracranial abnormalities.

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