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TRANSFONTANELLE ULTRASONOGRAPHY OF INFANT BRAIN: ANALYSIS OF FINDINGS IN 114 PATIENTS IN BENIN CITY, NIGERIA.

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ABSTRACT
Objectives: To analyse the pattern of findings in sonographic examination of infant brains.

Setting: Radiology Department of a University Teaching Hospital.

Materials and Methods: The ultrasound request cards, reports and case notes of 114 consecutive term infants who underwent transfontanelle ultrasonography over a four-year period (between 1st May 2000 and 31st April 2004) were retrospectively analysed. The transfontanelle ultrasonographies were done using a two dimensional Sonoace 1500 (Medison Inc, South Korea 1995) ultrasound scanner fitted with 6.5 megahertz (MHz) curvilinear small head probe. The scans were done in both coronal and sagittal sections applying the standard techniques.

Result: A total of 114 infants were seen in the study period with male to female ratio of 1:1. Sixty eight patients (59.65%) presented within the first 2 months of age. Hydrocephalus 34 (29.04%), seizure disorders 16 (14.04%) and suspected intracranial bleeding 19 (16.67%) constituted over half of the presenting complaints. The result showed that 54 patients (47.37%) had normal findings, 43 (37.72%) had hydrocephalus of which in 25 (21.93%) it was communicating while in 18 (15.79%) it was non-communicating 6 (5.26%) had cephalohaematoma, 5 (4.39%) had encephalcoele, 4 (3.51%) had periventricular leukomalacia, and 2 (1.75%) had subgaleal cyst.

Conclusion: Transfontanelle ultrasonography is a useful technique for diagnosis of lesions within the infant brain. Hydrocephalus is the most frequent reason for request of transfontanelle ultrasound scan and also the most frequent abnormal finding.

Key Words: Transfontanelle, brain, infants, analysis, ultrasonography. (Accepted 23 April 2009)

INTRODUCTION

Brain ultrasound scan through the anterior or posterior fontanel, using the fontanels as acoustic windows has been established as a simple, effective, accurate, cost effective and non-invasive modality of rapid examination of infant brain anatomy, determining normality and abnormality with great details.[1-3] Ultrasound is free from radiation hazard to the baby unlike plain skull radiography, conventional tomography or computed tomography (CT) scan and its cheapness and low power consumption has made it readily available in the developing countries even in the remote areas. Magnetic resonance (MR) imaging has excellent definition of pathology and anatomy but its cost significantly limits its availability for use in developing countries.[1,2] Nzeh et al[1] emphasised that effective utilisation of cranial ultrasonography offers the best practicable means of reliable imaging assessment of neonatal brain in the developing countries. When there is sutural splitting or when there is delay in closure of the fontanels, cranial ultrasound scan can be used to assess infant brain after 6 months of age.[4] The ultrasound transducer can also Image the brain in infants by applying them and scanning directly through very thin temporal bones. Hydrocephalus and intracranial haemorrhage are recognised as the commonest abnormality requiring confirmation or exclusion using transfontanelle ultrasonography.[1-6] Meningitis which is a common infection in developing countries is often complicated by hydrocephalus especially when poorly treated.[1,4] In congenital abnormalities of the brain, cranial ultrasonography offers excellent anatomical imaging of the brain.[3, 4] In separate studies by Ment et al[5], Behnke et al[6] and Boo et al[7] it was noted that MR imaging detects subtle changes of infant brain that did not correlate with eventual patient outcome after one year because of the adaptive capacity of the brain, where as all the lesions detected by ultrasonography correlated with eventual patients' outcome, which showed that ultrasonography is superior to MR imaging on clinical application especially when patients have to be counselled of the prognostic significant of the imaging findings. Other lesions that ultrasonography can detect include subdural effusion, subdural haematoma, intraventricular haemorrhage, intracerebral haemorrhage, periventricular leukomalacia and several types of congenital abnormalities of infant brain.[1,4]

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MATERIALS AND METHODS

The study was carried out at the Department of Radiology of a University Teaching Hospital. The hospital has a neonatal unit which is within the Paediatric Department from where majority of the patient for this study were referred. However a few patients were referred from nearby private hospitals.

Transfontanelle ultrasound scanning was carried out using real time two dimensional B-mode Sonoace 1500 scanner (Medison Inc, South Korea 1995). The transducer used was a 6.5 MHz curvilinear small head probe. The scans were done by radiologists during the normal working hours. The ultrasound scans were carried out over a four-year period, between 1st May 2000 and 30th April 2004. Both coronal and sagittal sections were done involving the standard planes. Scans were occasionally done in transverse section over thin temporal bones.

The materials studied were obtained from medical records of the Radiology Department and the hospital medical records general archive. A retrospective analysis of ultrasound request forms, duplicate ultrasound scan reports and case notes of 114 consecutive infants who under went cranial ultrasound scan in our centre were done.

RESULT

Fifty four patients (47.37%) that had cranial ultrasound scan had normal findings while 60 (52.63%) had abnormal findings. Fifty eight patients (50.88%) were male while 56 (49.12%) were females with male to female ratio of 1:1. Among the patients with abnormal findings, 43 (37.72%) had hydrocephalus (Figures 1 and 2). These comprised of 25 (21.93%) with communicating hydrocephalus while 18 (15.79%) had non-communicating hydrocephalus. Six patients (5.26%) had cephalohaematoma, 5 (4.39%) had encephalocoele, 2 (1.75%) had subgaleal cyst (Table 1,Table 2,Table 3). Two patients with communicating hydrocephalus had Dady-Walker syndrome. Among the presenting complaint, 34 patients (29.82%) presented with suspected hydrocephalus, 16 (14.04%) seizures disorder, 19 (16.67%) suspected intracranial haemorrhage, 17 (14.91%) post meningitis treatment for reassessment, 10 (8.77%) encephalocoele, 3 (2.63%) birth trauma, 3 (2.63%) hemiatrophy, 3 (2.63%) unilateral proptosis, 4 (3.51%) microcephaly, 3 (2.63%) subcutaneous scalp swelling and 2 (1.75%) parietal prominence.

Most of the transfontanelle ultrasonographies were done within the first six months of life. Fifty four (47.37%) patients were examined during neonatal period, of which 31 (27.19%) were within the first seven days of life, 23 (20.18%) within second to four weeks, 14 (12.28%) patients between one and two

Table 1: **Age at Presentation for Ultrasound Scan.**

Age	Male	Female	Total	Percentage
0-7 days	13	18	31	27.19
8-28 days	15	8	23	20.18
1 -2 months	5	9	14	12.28
2 -3 months	10	6	16	14.04
3-4 months	11	10	21	18.42
4 -5 months	4	3	7	6.14
5 -6 months	0	2	2	1.75
Total	**58**	**56**	**114**	**100**

Table 2: **Frequency of Presenting Complaint.**

Presenting complaint	Number	Percentage
Hydrocephalus	34	29.04
Seizure disorder	16	14.04
Intracranial haemorrhage	19	16.67
Post meningitis treatment	17	14.91
Encephalocoele	10	8.77
Birth trauma	3	2.63
Hemiatrophy	3	2.63
Unilateral proptosis	3	2.63
Microcephaly	4	3.51
Subcutaneous scalp swelling	3	2.63
Parietal prominence	2	1.75
Total	**114**	**100**

Table 3: **Ultrasonic Findings.**

Ultrasonic findings	No.	Percentage
Normal	54	4.37
Hydrocephalus	43	37.72
Communicating 25 (21.98%)		
Non communicating 18(15.79%)		
Cephalohaematoma	6	5.26
Encephalocoele	5	4.39
Periventricular leukomalacia	4	3.51
Subgleal cyst	2	1.75
Total	**114**	**100**

Figure 1: **Sonographic Image of Hydrocephalus (Coronal section) showing Dilated Ventricles. RLV = Right lateral ventricle, LLV = Left lateral ventricle, 3V = Third ventricle, 4V = Fourth ventricle.**

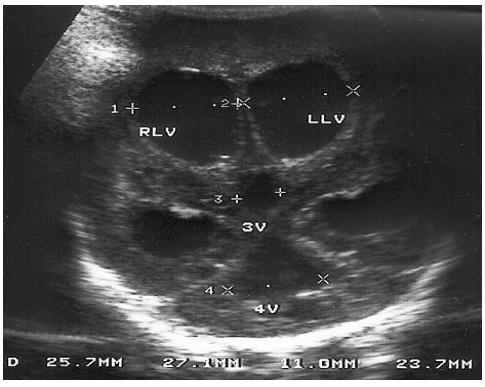
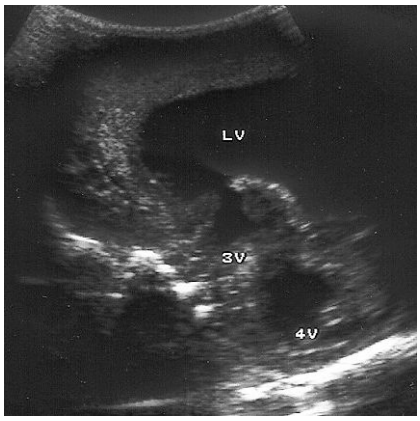


Figure 2: **Sonographic Image (Sagittal section) of Hydrocephalus showing Dilated lateral, third and fourth Ventricles.**



months, 16 (14.04%) patients were seen between two to three months, 7(6.14%) patients were seen between four to five months while only 2 (1.75%) patients were seen between five to six months of life.

DISCUSSION

The pattern of transfontanelle ultrasonographic findings may be useful in intervention and treatment of conditions known to be predisposing factors to these complications in developing countries.[1-5] Though hydrocephalus may be congenital, the importance of meningitis in its pathogenesis cannot be over emphasised.[4] The primary goal of transfontanelle ultrasonography is to demonstrate brain anatomy. The percentage of normal findings (47.37%) noted in this study correlates with the study by Ajayi and Nzeh [8], which recorded (47%). The percentage of hydrocephalus of 37.73% also correlates with another study by Nzeh et al[1] which recorded 38% of hydrocephalus. Only 7 (6.14%) of our patients had congenital anomaly. Among this number 2 (1.75%) had hydrocephalus with lesions of the cerebellum while 5 (4.39%) had encephelocoele. This does not agree with the study by Nezh et al[1] that recorded 25.5% of congenital anomaly. Majority of our patients (85.96%, n=98) were term infants and only 4(3.51%) were diagnosed to have periventricular leukomalacia which is more common in preterm low birth weight babies.[9] Intracerebral and intraventricular haemorrhage surprisingly were not record in this study. It is possible that some cases of hydrocephalus may have had haemorrhages at earlier age but were not recognised due to lack of early utilization of ultrasonography. They may have been referred for ultrasonography only when the complications became obvious. Subgaleal cyst and cephalohaematoma though not intracranial lesions, were included in this study because patients presented with symptoms which made the referring paediatricians to suspect intracranial lesion; the brain structures were normal in both of them. Transfontanelle ultrasonography requires patience, empathy, care, high knowledge and competence from record of large number of studies during training of the operator.[10,11] It is very important for the sonologist to be very conversant with the different appearances of skull bones in various transducer positions, directions or planes to avoid both false positive and false negative diagnosis from artifacts. Repeat studies are needed in cases of early suspicion of hydrocephalus. Assurance of normality should be replaced by emphasis of the need for follow up as cases that may be dismissed as normal may come up later with gross hydrocephalus. Loss to follow up is very rampant in developing countries due to ignorance, poverty and far distance between the cities where the big hospital are located and the rural areas where most patients live. Once the patients visited the hospitals and their problems are not solved, they often respond by visiting traditional healers and spiritual churches seeking supernatural help.[11-14] False negative and false positive findings encourage these practices. It is often rewarding for at least two radiologist or sonologists and the requesting paediatrician to be present during the study and the conclusion arrived at by consensus especially when the lesion is not gross or very obvious. Dual reading by two radiologists, radiologist and paediatrician, radiologist and paediatric neurologist, or radiologist and neurosurgeon have been shown in previous studies to improve accuracy and reduce errors.[15] In Africans, meningitis is commonest in children aged less than 2 years and every effort must be made to diagnose it and any associated complications at an early stage to avoid long term neurological damage.[16] Hydrocephalus is the commonest reason for request of neurosonography in this study, and the commonest complications in the findings and therefore objective assessment of the ventricular sizes is necessary to detect any dilatation at early stages.

It is expected that with improved awareness of the capacity of cranial ultrasonography to diagnose or exclude brain lesions, there will be an improvement in early requests for the examination and the performance of radiologists. Improved correlative interactions between the radiologists and paediatricians with the aim of improving early diagnosis will help to reduce neonatal and infant mortality and morbidity from treatable intracranial lesions.

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