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Ultrasonographic Evaluation of Hydrocephalus in Children

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Abstract

This cross sectional study was carried out in the Department of Radiology and Imaging, Bangabandhu Sheikh Mujib Medical University (BSMMU) along with Department of Paediatric surgery of BSMMU. Total 30 patients were selected purposively. All patients were from 0 to 3 years age. Mean age of the study group was 1.16 ± 1.35 years. In the study series 56.7% were male and 43.3% were female with a male female ratio of 1.3:1. Commonest presenting complaint associated with hydrocephalus was history of poor feeding (93.3%) and irritability (93.3%). 73.3% had reduced activity, 63.3% had drowsiness, 60% had large head, 30% had neck rigidity, 16.7% had fever and 16.7% had vomiting. 73.3% patients had hypoechoic and 26.7% had echogenic ventricular appearance on ultrasonography. Mean (± SD) diameter of lateral, 3rd and 4th ventricle was 24.2(± 4.33) mm, 8.16 (± 2.40) mm and 8.87(± 1.64) mm. Sonographically 73.3% patients had serous fluid and 26.7% had either blood or pus in their ventricles, 70% had aqueductal stenosis. Ultimate diagnosis was made as congenital hydrodrocehalus (36.7%), tumour (33.3%), infection (16.7%) and haemorrhage (13.3%). With the study results ultrasonography can be accepted as an initial imaging modality in the evaluation of hydrodrocehalus in pediatric patient.

Key words: *Ultrasonography, Hydrocephalus*

Introduction:

Hydrocephalus can be defined broadly as a disturbance of formation, flow, or absorption of cerebrospinal fluid (CSF) that leads to an increase in volume occupied by this fluid in the central nervous system (CNS). This condition also could be termed a hydrodynamic disorder of CSF. Acute hydrocephalus occurs over days, sub-acute over weeks, and chronic over months or years. Conditions such as cerebral atrophy and focal destructive lesions also lead to an abnormal increase of CSF in CNS. In these situations, loss of cerebral tissue leaves a vacant space that is filled passively with CSF. Such conditions are not the result of a hydrodynamic disorder and therefore are not classified as hydrocephalus. An older misnomer used to describe these conditions was hydrocephalus ex vacuo.

Prior to the late 1970s, ultrasonic examination of the intracranial contents in infants and young children was limited to A-mode presentations. With the advent of the Octoson and of sector-format real-time ultrasonic instruments, two-dimensional imaging of infant heads became a reality. Resolution and image display is equal to that obtained with computerized tomography and in some cases appears to be superior. The technique is now in widespread use, particularly in centers with neonatal intensive care units. Its non-invasive, rapid nature makes ultrasonographic examination the procedure of choice. Sedation is not necessary. The diagnostic uses of ultrasound in evaluating intracranial pathology range from evaluation of response to ventriculoperitoneal shunting in hydrocephalic patients to initial diagnosis of germinal matrix hemorrhage, neoplasms, and congenital malformations[1].

Infantile hydrocephalus is a common disease. In most affected children the process starts before

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the age of 2 years when the anterior fontanel is still open. Brain sonography has emerged as an effective tool in diagnosing progressive ventricle dilation and may be used for continuous follow-up. It gives important information as: (a) cortical thickness, an expression of proper shunt function and of prognostic value concerning neuro-psychological development; (b) position of the tip of the catheter, which is considered by some to be a predictive factor of shunt failure; (c) other complications such as subdural collections, isolated IV ventricle, and slit ventricles. This procedure permits frequent examinations and allows better comprehension of the pathological process by the parents and medical staff[2].

Sonographic evaluation of the brain offers a noninvasive, safe and inexpensive method in diagnosis and follow-up of hydrocephalus associated with meningomyelocele. Cranial computed tomography should be reserved for special questions such as assessment of bony structures, subdural effusions or if fontanels and sutures are already closed. Ultrasound of the neonatal head is completely harmless, repeated examinations can easily be performed and sedation of the infant is usually not necessary. The method of ultrasound sections in different directions is demonstrated and compared to axial CT sections. Value, effectiveness and diagnostic interpretation of the method are demonstrated in four cases: 1. Small lumbar meningomyelocele with mild hydrocephalus without enlargement on follow-up. 2. Giant spinal defect with kyphoscoliosis, marked hydrocephalus and associated ventricle abnormalities. 3. Sonographic follow-up after ventriculo-atrial shunting in a patient with congenital hydrocephalus. 4. Cerebrospinal fluid abdominal pseudocyst after ventriculo-peritoneal shunting. Thus ultrasound is an excellent method for following ventricular size and shunt-function in meningomyelocele-patients[3].

Real-time ultrasonography of the brain is useful in the examination of neonates with suspected hydrocephalus. Abnormalities of the cerebral ventricles can be identified and changes in ventricular size determined with repeated studies performed at the bedside. The response of hydrocephalus to medical and surgical intervention can be monitored. We studied cases of hydrocephalic infants with myelomeningocele, posterior fossa cyst, post hemorrhagic hydrocephalus, meningitis, and congenital intracranial teratoma. We also studied the role of ultrasonography in the diagnosis and follow-up of these cases[4]. The present study was undertaken to evaluate the utility or ultrasonography in the diagnosis of hydrocephalus baby.

Materials and methods:

This cross sectional study was carried out on 30 patients with clinically suspected hydrocephalus with age range from 0-3 yrs in the Department of Radiology and Imaging in collaboration with the Department of Paediatric Surgery, BSMMU, Dhaka from October 2007 to September 2008. Purposive sample was taken in consecutive patients. All clinically and sonographically diagnosed hydrocephalic children of both sexes were included in this study. Hydrocephalus with shunt and large head with closed fontanel were excluded. All the patients were evaluated by detail history, socioeconomic, clinical examinations and ultrasonography. The ideal equipment for the examination of the infant brain is a high-resolution sector real-time scanner, fitted with a 5 MHz (or higher frequency) transducer. The real-time transducer was placed over the patient's anterior fontanelle to obtain coronal and sagittal scans of the brain. When the posterior or lateral fontanelles were open these were also used as scanning windows. All the necessary information regarding the research study, data were collected in a pre-diagnosed structure data collection sheets (proforma). All the relevant connected data were compiled on a master chart first and then organized by scientific calculator and standard appropriate statistical formula. Percentages were calculated to find out proportion of the findings. Further statistical analysis of the results were

obtained by using window based computer software device with statistical packages for social science (SPSS-13).

Results and observations:

In our study 56.7% were male and 43.3% were female. Male and female ratio was 1.3:1. Maximum 43.3% patients were up to 6 months age group followed by 23.3% within 6 months to 1 year age groups and 20% within 1-2 years and 13.3% above to years. Means age was 1.16 ± 1.35 years. All patients within 0.1 -3 years age range mean head circumference of the patients was 48.5 ± 3.63 cm with range from 41 -58 cm. Out of all patients 93.33% had history of poor feeding, 93.3% had irritability, 73.3% had reduced activity, 63.3% had drowsiness, 60% had large head, 30% had neck rigidity, 16.7% had fever and vomiting was present in 16.7% children.

Table I

Ultrasonographic measurement of all ventricles

Ventricle Involved	Mean ± SD in mm	Range (mm)
Lateral ventricle (Frontal horn)	24.2 ± 4.33	18-40
3rd ventricle	8.16 ± 2.40	3-12
4th ventricle	8.87 ± 1.64	6-10

Mean (± SD) diameter of lateral, 3rd and 4th ventricle was 24.2 (± 4.33) mm, 8.16 (± 2.40) mm, 8.87(± 1.64) mm

Table II

Distribution of the patients by USG feature of ventricle

Ventricular appearance	Frequency	Percent
Hypoechoic	22	73.3
Echogenic	8	26.7
Total	30	100.0

On USG 73.3% patients had hypoechoic and 26.7% had echogenic ventricular appearance.

Table III

Distribution of the patient by their site of ventricular enlargement

Involved Ventricle	Frequency	Percent
Lateral	30	100
Third	27	90
Fourth	8	26.7

All patients had dilated lateral ventricle, 90% had dilated 3rd ventricle and 26.7% had dilated 4th ventricle.

Table IV

Distribution of the patients by ventricular contents (n=30)

Ventricular contents	Frequency	Percent
Blood /pus	8	26.7
Clear fluid	22	73.3
Total	30	100

Of all patients 73.3% had clear fluid and 26.7% had either blood or pus in their ventricles.

Table V

Distribution of the patients by aqueduct stenosis (n=30)

Aqueduct stenosis	Frequency	Percent
Present	21	70
Absent	9	30
Total	30	100

Out of all patients (70.0%) had aqueductal stenosis.

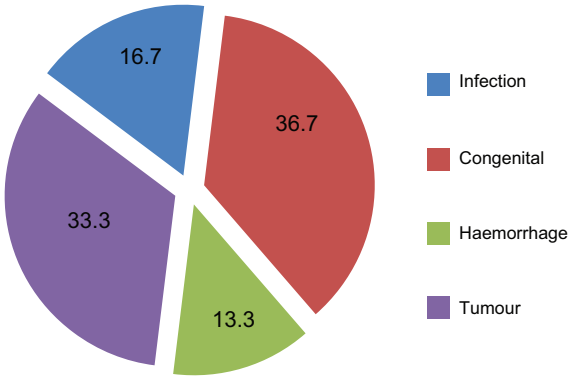

Fig.-1: *Etio-diagnosis of hydrocephalus baby by sonography.*

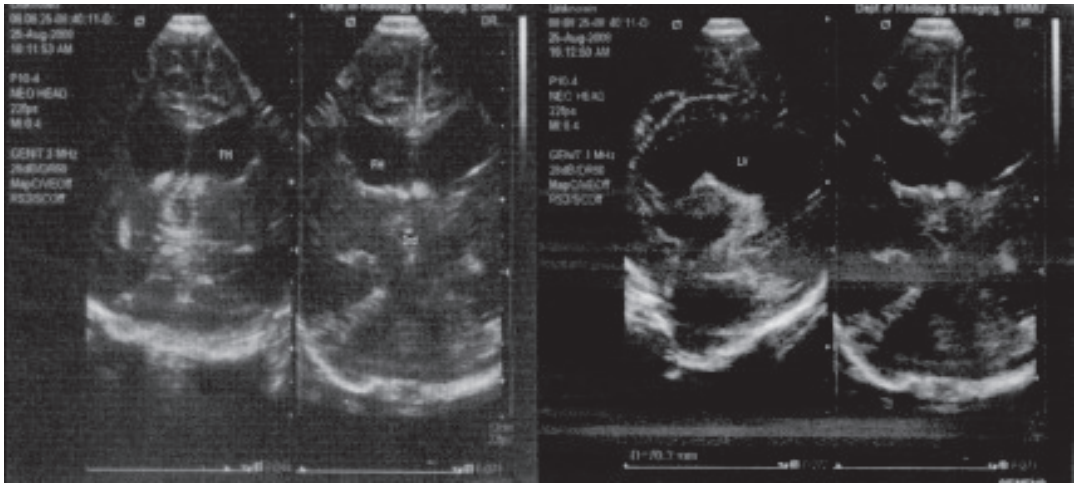

Fig 1a,b: *USG of brain showing dilated frontal horns of lateral ventricles*

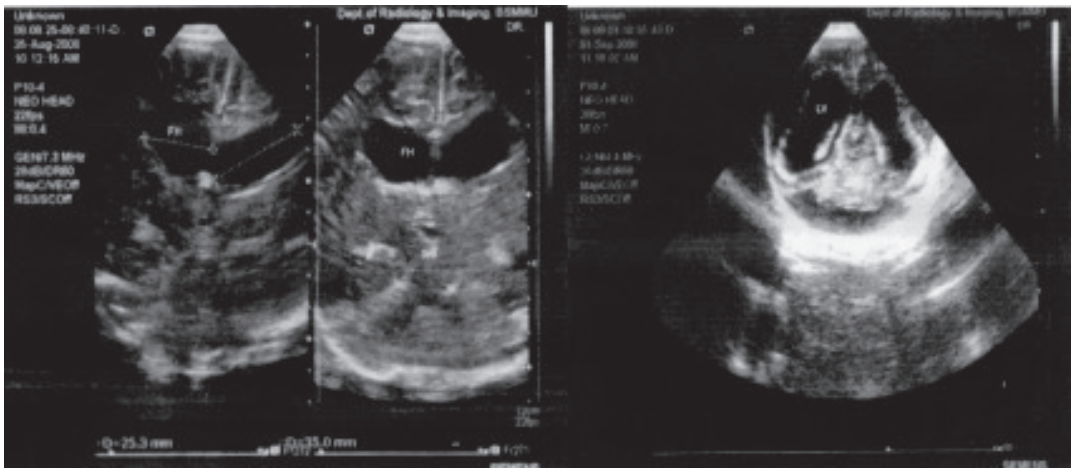

Fig.-2a,b: *USG of brain showing dilated lateral ventricles*

Fig.-3: *USG of brain showing dilated lateral and 3rd ventricles*

Discussion:

This cross sectional study was carried out in the department of Radiology and Imaging and Paediatric surgery of BSMMU. Total 30 patients were selected purposively.

Out of all patients of our series 56.7% were male and 43.3% were female. Male and female ratio was 1.3:1. Maximum 43.3% patient were up to 0-6 months age group followed by, 23.3% within 6 months to 1 years age group and 20% within 1 to 2 years and 13.3% above 2 years. Mean ± SD age of the patients was 1.16 ± 1.35 years. All patients were within 0.1 to 3.0 years. The presenting symptoms in children were history of poor feeding, irritability, headache, nausea, vomiting and

lethargy. So this study findings are similar to the study by James[5].

In our series 93.33% patients had history of poor feeding, 93.3% had irritability, 73.3% had reduced activity, 63.3% had drowsiness, 60% had large head, 30.0% had neck rigidity 16.7% had fever and vomiting was present in 16.7%. Ahmed et al[6] showed in his study that the main clinical features of children group were: macrocephaly (81.3%), vomiting (18.8%), fits (13.8 %) and headache (11.3%). Only 5 % patients in this group were found to have papilloedema.

In our series 73.3% patients had hypoechoic and 26.7% had echogenic ventricular appearance. Low-level echogenicity is a frequent feature of various body fluids, including malignant ascites, abscess, and flowing venous blood. Grant et al. identified low-level echogenicity in over half of their patients who had significant post hemorrhagic hydrocephalus[7]. In our series 13.3% hydrocephalus baby had sonographic feature of haemorrhage.

Mean (± SD) head circumference of the patients was 48.5 ± 3.63 mm. All patients had dilated lateral ventricle, 90% had dilated 3rd ventricle and 26.7% had dilated 4th ventricle. Mean (± SD) diameter of lateral, 3rd and 4th ventricle was 24.2 (± 4.33), 8.16 (± 2.40), 8.87 (± 1.64) mm. During ultrasonograpahic examination 73.3% patients had serous fluid and 26.7% had either blood or pus in their ventricles and 70% had aqueductal stenosis. Ultimate diagnosis was made as congenital hydrdrocehalus (36.7%), tumour (33.3%), infection (16.7%) and haemorrhage (13.3%).

Conclusion:

Ultrasonography can be accepted as an initial imaging modality in the evaluation of hydrocephalus in pediatric patients before the closure of fontanel because it provides reliable and accurate information needed in the diagnosis of hydrocephalus in that age group. It is a noninvasive and cost effective modality.

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