CRANIAL SONOGRAPHY IN BACTERIAL MENINGITIS

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ABSTRACT

Cranial ultrasonography was performed on 61 infants with acute bacterial meningitis (ABM). Thirty nine, infants (64%) had acute meningitis with no clinical evidence of complications (Group-I) and 22 infants (36%) had clinical evidence of complications of ABM (Group-II). Cranial ultrasound was normal in 20 infants (32.8%). The spectrum of sonographic abnormalities included echogenic sulci (60.6%), sulcal separation (49.8%), abnormal parenchymal echoes (42.6%), ventriculomegaly (34.4%), ventriculitis (19.7%), abscess (3.3%), subdural empyema (1.63%) and hemorrhagic infarct (1.63%). Various abnormal findings were seen in all 22 patients of Group II (100%) and in only 19 out of 39 patients in Group I (31.9%). Cranial sonography was comparable to CT scan done in 10 cases of Group II. Our study suggests that ultrasound is a quick, reliable and effective diagnostic tool in diagnosis and management of infants with or without evidence of complications.

Keywords: *Bacterial meningitis, Ultrasound, CT scan, subdural empyema.*

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Cranial sonography is reported to be an excellent diagnostic tool for early and timely detection of the complications associated with acute bacterial meningitis (ABM)(l-3). In view of this, a prospective study of 61 patients with ABM was undertaken to determine the abnormalities seen on cranial ultrasonography (US), to evaluate its usefulness in diagnosing complications, the therapeutic significance of US findings and to compare this modality with CT scan.

Subjects and Methods

Sixty one patients of ABM were included in the study based on diagnostic criteria of : (a) history and clinical examination, *(b)* CSF analysis in form of polymorphonuclear leukocytosis, raised proteins and low sugar content, (c) latex examination of CSF for *H. influenzae, S. pneumbniae* and *N. meriingitidis, (d)* CSF culture. The patients were divided in two groups. *Group I* (n=39): consisted of infants of ABM on therapy with no clinical suspicion of complications and subsequent CSF examination at 48 hours showing improvement. *Group II* (n=22): consisted of patients with clinical evidence of complications, *viz.,* persistent seizures, neurological signs and symptoms, and subsequent CSF examination at 48 hours showing deterioration.

All these patients were subjected to cranial sonography on days (D) 1, D 3, D $\geq$ 10 (at completion of antibiotic therapy). Sim 3000 real time sector scanner with 3.5 or 5 MHz transducer was used to perform the scanning. Images were recorded on multiformat camera; transfontanelle, coronal, sagittal parasagittal and transaxial scans were obtained in all cases. Patients were evaluated for

echogenic sulci, sulcal separation, abnormal parenchymal echoes, ventri—culomegaly (mild-VHR 1:3, moderate - VHR 1:2, severe VHR 1:1), ventriculitis, choroid plexitis, ventricular exudates, septae, abscess, subdural empyema and infarct.

Results

Infantile bacterial meningitis was seen in 61 patients. The 46 (75.4%) males and 15 (24.6%) females presented with a spectrum of sonographic findings *(Table I)*. Cranial US was normal in 20 cases (32.8%) (all in Group 1). Nineteen (47%) cases of Group I showed abnormal US findings. The most common US abnormalities were echogenic sulci and sulcal separation *(Fig. 1);* seen in 42% cases of Group I and 90.9% of Group II infants. Abnormal parenchymal echoes were more common in Group II (82%) as compared to Group I (20%). Likewise ventriculomegaly was more common in Group II (78%) as compared to Group I (10%). Ventriculitis, an important complication of pyogenic meningitis, was more common in Group II (40.9%). However, 3 patients (7.5%) of Group I also had US evidence of ventriculitis. Intraventricular septae were seen in 13.6% of Group II infants. Serious complications like brain abscess were observed in 9% of cases and subdural empyema in 4.5% of cases of Group II *(Fig. 2).* Three cases of Group II expired, two of them had ventriculitis with septae *(Fig. 3)* and one had severe ventriculomegaly with choroid plexitis. Patients of subdural empyema and abscess were treated successfully because the complications were detected early by cranial US.

TABLE I—*Abnormal Sonographic Findings in Bacterial Meningitis*

Findings	Group I (n=39) (Normal=20, Abnormal=19)	Group II (n=22) (Abnormal=22)
Echogenic sulci	17 (42)	20 (91)
Sulcal separation	14 (35)	16 (73)
Abnormal parenchymal echoes	8 (20)	18 (82)
Ventriculomegaly		
Mild/mod	4 (10)	13 (59)
Severe	-	4 (19)
Ventriculitis	3 (8)	9 (41)
Choroid plexitis	1 (3)	7 (32)
Exudates/septae	1 (3)	8 (37)
Cerebral abscess	-	2 (9)
Subdural empyema	-	1 (5)
Hemorrhagic infarct	-	1 (5)

CT scan head was done only in ten infants of Group II *(Fig. 4)* and the findings correlated well with cranial US. Latex examination of CSF was positive in 13 patients (21.3%) for *H. influenzae,* and 7 patients (11.4%) for *S. pneumoniae.* CSF culture was sterile in all cases.

Discussion

Cranial US has firmly established itself in management of infants with bacterial meningitis(l). Despite appropriate antibiotic therapy, 15-20% infants of complicated bacterial meningitis die in the acute phase while as many as 50% of such infants develop neurological sequelae(4). The rationale of D3 US was to look for any significant change in US findings mainly in Group II cases.

Increase in sulcal echogenicity and sulcal separation was due to inflammatory exudates accumulating in sulci(l). The incidence of echogenic sulci was relatively high (62%) in our study *(Table II).* We attribute this to subjective nature of the finding. Abnormal parenchymal echoes, diffuse or localized represents cerebritis or infarction, common in complicated meningtis carrying poor prognosis as reported earlier(6). Increased parenchymal echogenicity with chinked ventricles suggested cerebral edema and this required prolonged decongestive therapy.

Ventriculomegaly was seen in 34% cases which was consistent with other studies *(Table II).* In the acute phase of pyogenic meningitis, the normally

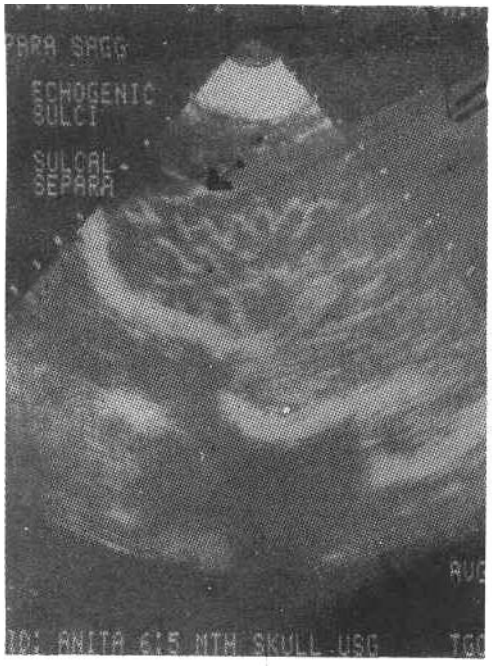

Fig. 1. Parasaggital ultrasound scan showing echogenic sulci with sulcal separation (←).

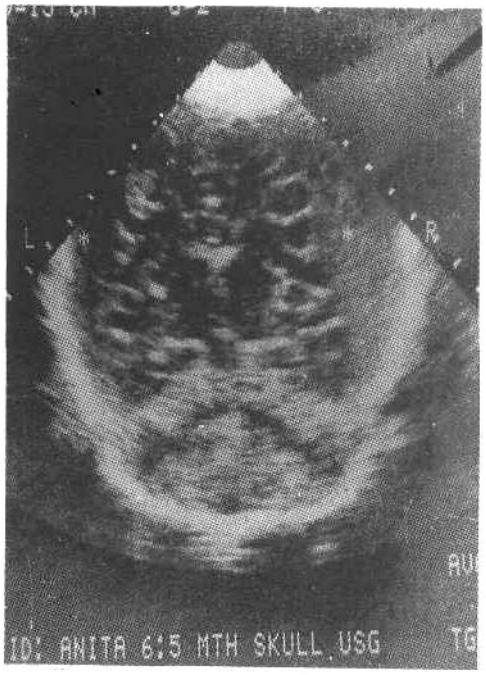

Fig. 2. Coronal ultrasound scan showing bilat eral subdural empyema (Right > Left).

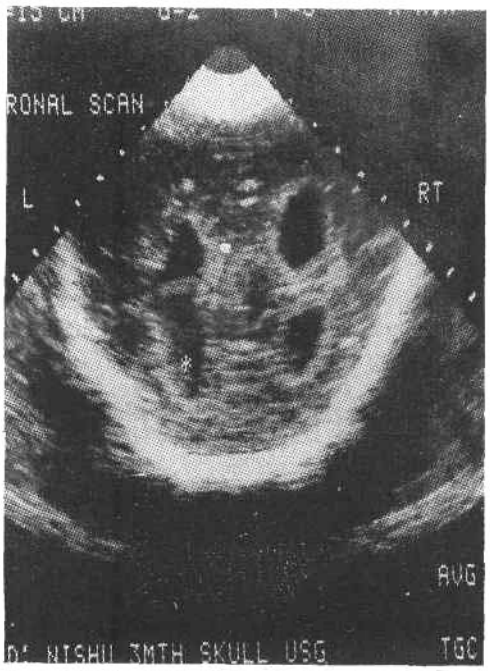

Fig. 3. Coronal ultrasound scan showing bilateral dilated lateral ventricles with evidence of ventriculitis.

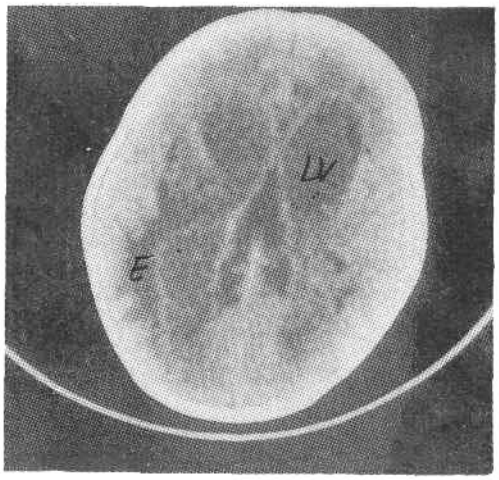

Fig. 4. Axial CT scan showing dilated lateral ventricles (LV) with enhancing walls and periventricular edema (E).

smooth choroid plexus and ventricular walls become irregular, thickened and hyperechoic as the purulent exudate is laid down, later on with gliosis septae formation takes place. These changes were also reported in infants of bacterial meningitis having complications(7,8). Also, ventricular reservoir of infection may be present despite sterile lumbar CSF(8). In our study, ventriculitis was seen in 40.9% of Group II and interestingly 7.5% of Group I also had sonographic evidence of ventriculitis and were successfully treated. This highlights the importance of sonography in the management of ABM, particularly in those cases who have ultrasound abnormalities without clinical evidence of complications.

Subdural empyema (4.5%) and abscess (9%) were associated with complicated meningitis group having a poor prognostic significance(l,3,9). However, our patients were managed successfully owing to timely detection of these complication.

CT scan proved comparable to cranial US, in the few subjects in whom both investigations were performed. Intraventricular complications were better appreciated on US as also reported earlier (7). However, CT is required before active surgical intervention. Small subdural effusion is better seen on CT scan and may be missed on US with low frequency transducer(l). Low cost, ease of examination, absence of sedation, portability and lack of radiation are advantages of cranial US over CT scan.

It is concluded that cranial sonography is a reliable and informative imaging modality for diagnosis and management of ABM with or without

TABLE II—*Comparison with Earlier Reports*

Author	Reported ultrasound findings			
	Number studied	Normal (%)	Echogenic sulci (%)	Ventriculomegaly(%)
Edwards *et al.*(5)	20	8 (40)	6 (30)	12 (60)
Han *et al.*(3)	78	30 (39)	31 (40)	11 (14)
Chowdhary *et al.*(2) (all US abnormal cases)	70	-	62 (90)	26 (40)
Moorthy *et al.*(1)	51	16 (32)	12 (24)	24 (48)
Present study	61	20 (33)	37 (62)	21 (34)

complications. We recommend cranial US in all cases of ABM while CT scan may be reserved for selected cases only.

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