BACTERIAL MENINGITIS: DIAGNOSIS BY LATEX AGGLUTINATION TEST AND CLINICAL FEATURES

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ABSTRACT

To know the usefulness of Latex Agglutination Test (LAT) for the diagnosis of bacterial meningitis (BM), it was performed in all the 114 consecutive samples of CSF with polymorphs from 114 prospectively recruited children aged 2 months to 11 years. Definite diagnosis of BM based on culture and/or LAT was evident in 55. Among the 46 LAT positive, culture was positive in 3 only. Major organisms identified by LAT were H. influenzae B (HiB) in 28 and S. pneumoniae (SP) in 15. Ninety per cent of HiB and 67% of SP bacterial meningitis were under one year of age.

Fever >7 days prior to admission was not uncommon (38%) and 26% had received prior antibiotics. Meningeal signs were present in 64%. CSF cells were <500/mm^3 in 24% and sugar was >50% of blood level in 23%. There was no significant difference in the immediate outcome between HiB and SP meningitis. The case fatality was 22% and was significantly high in cases who had altered level of consciousness on admission ($p=0.02$). It is concluded that LAT is very useful for rapid diagnosis of BM.

Key words: *Bacterial meningitis, Latex agglutination test.*

Etiological diagnosis of bacterial meningitis (BM) by CSF culture in India, in the best of the laboratories, is achieved only in 25 to 40%(1,2). CSF Gram stain is also positive only in about 25 to 30%(1). The culture results are available only after two or three days. These low positive values are attributed to prior exposure to antimicrobials, defect in transport or/and collection of the specimens and may be inadequacy in the process of culture(3). Therefore, most of the time, treatment is given on an empirical basis. It is essential to diagnose BM and its etiological agent for proper management. Diagnosis by Latex Agglutination Test (LAT) is highly sensitive (95 to 100%) and specific (98 to 100%)(4-9). The test is simple to perform, no special equipment is required, technically easy and results are available in 10 minutes but it is very expensive. The objective of the study was to assess the usefulness of LAT for specific etiological diagnosis of BM.

Material and Methods

Children between 2 months and 11 years suspected to have acute meningitis and who had polymorphs in the CSF were prospectively recruited for the study from January 1989 to April 1990 at the Institute of Child Health. CSF was examined for its characteristics and for organisms by Gram stain, culture and LAT. Children exposed to antibiotics for >48 hours prior to admis-

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Received for publication: April 6, 1992; Accepted: December 24, 1992

sion or treated elsewhere as BM were excluded. Under aseptic precautions three aliquots of CSF were collected, first one for culture and Gram stain, second for cell count and biochemistry and third for LAT. The CSF specimens were coded for LAT and laboratories. Prior use of antimicrobial, their names, dose and route of administration were ascertained. Cell count was done using Neubauer counting chamber and WBC fluid(10). Gram stain was done within one hour using centrifuged specimen. Culture was done as per standard procedures.

LAT was done by a single independent investigator who was blind to the clinical details. The kit used was Wellcogen of Wellcome Company, UK. It is provided with sera to detect antigen of common etiological agents of BM namely *N. meningitides* A, B, C, Y, W 135 (NM), *S. pneumoniae* (SP), *H. influenzae* B (HiB), Streptococci group B and *E. coli* K1. The procedure described in the enclosed literature of the kit was followed. Results made available by the tests were communicated to the physician treating the child so that appropriate treatment was instituted. Assessment of nutritional status was based on IAP recommendations(11).

Results

Of the 114 CSF tested, definite diagnosis was evident in only 55 based on CSF culture and/or LAT. The etiological organisms are shown in *Table I.* Culture was positive in 12 (22%) cases whereas LAT was able to identify the etiological agents in 46 (84%) cases. Among the organisms identifiable by LAT, only 3 out of 46 were culture positive, all SP. Other organisms identified by culture were *S. aureus* 4, *E. coli* 1, *Klebsiella* 1, *Pseudomonas* 1 and *Proteus* 1. Ninety per cent (25/28) of the HiB and 67% (10/15) of the SP cases were under one year of age. It is possible a few of BM might have been misclassified as false negative among the CSF culture negatives and very few or none among LAT negatives since the sensitivity of LAT is high (95 to 100%). We presume this to be due to poor culture yield among the organisms that could not be identified by LAT.

TABLE I—*Identification of Etiological Organisms by Culture and Latex Agglutination Test*

Organism	Culture	Latex	Total
H. influenzae type B	0	28	28
S. pneumoniae	3	15	15
N. meningitidis (A, B, C, Y, W135)	0	1	1
Group B *Streptococcus*	0	2	2
E. coli	1	0	1
S. aureus	4	0	4
Klebsiella	1	0	1
Pseudomonas	1	0	1
Proteus	1	0	1
Others	1	0	1
	12	46	55

The clinical and laboratory features and outcome of the 55 confirmed BM cases are shown in *Table II.* Eighty per cent of BM were under one year of age and 74.5% were malnourished. Prolonged fever more than seven days prior to admission was not uncommon (38%). Twenty six per cent of cases had received antibiotic prior to admission. Level of consciousness at the time of admission was normal in 45% of cases. Six cases had radiological evidence of lobar

TABLE II—*Clinical Features, Laboratory Findings and Outcome of Bacterial Meningitis (n=55)*

Features	Cases	
	n	(%)
Age (months)		
<12	44	(80.0)
≥12	11	(20.0)
Sex: Male	35	(63.6)
Nutritional status		
Normal	14	(25.5)
Grade–I	15	(27.3)
Grade–II	16	(29.0)
Grade–III & IV	10	(18.2)
Convulsions	36	(65.5)
Level of consciousness		
Normal	25	(45.5)
Altered	30	(54.5)
Meningeal signs+	34	(61.8)
CSF Findings		
Appearance		
Colorless	8	(15.5)
Opalescent	16	(29.1)
Turbid	31	(56.4)
Cell count/mm^3		
<100	3	(5.5)
100-499	10	(18.2)
500-999	7	(12.7)
>999	35	(63.6)
Protein (mg/dl)		
<100	16	(29.1)
100-499	34	(61.8)
>500	5	(9.1)
CSF/Blood sugar (n=51)		
<50%	39	(76.5)
≥50%	12	(23.5)
Hospital stay (days)		
<14	30	(54.6)
≥14	25	(45.4)
Outcome		
Recovered	33	(60.0)
Partially recovered	10	(18.2)
Died	12	(21.8)

pneumonia out of which one each had HiB and SP meningitis. Three cases had bronchopneumonia and all of them had HiB meningitis.

Total cells in the CSF were <1000/mm^3 in 36% and <500/mm^3 in 24%. CSF sugar was more than 50% of blood level in 23%. The outcome of BM in relation to certain risk factors is shown in *Table III.* There is no statistically significant difference in the case fatality between children under or more than 12 months and well-nourished and under-nourished. There was no significant difference in the outcome among the two major etiological agents. (HiB and SP) Case fatality was significantly high in cases who had altered level of consciousness on admission (p = 0.02)

Discussion

Etiological diagnosis of BM by culture has always been low in India ranging from 1 to 45%, similar to our data(1,2,12). Of the 55 confirmed cases of BM, LAT was positive in 46 (84%) cases, similar to the reported findings in India(12). Singh obtained an etiological diagnosis in 92% with multiple diagnostic tests–CIEP, LAT and COA using clinical criteria as gold standard(12). Grubbauer could detect bacterial antigens in 66 to 100% of cases of BM depending upon the organisms(4). Others have detected 100% of BM by LAT(5,6). Organisms identified by antigen tests and culture are similar to that reported except that *S. aureus* is not an uncommon agent in developing countries(1). Our data shows that majority of the BM occurs under 12 months of age. This is similar to reported findings in Indian studies(12,14). Delayed hospital admission after 1 or 2 weeks of illness is not uncommon. This has also been the observation in other Indian studies(13,15). Our data reveals that 26% of

TABLE III–*Outcome in Bacterial Meningitis in Relation to Risk Factors (n = 55)*

Risk factors	Total n	Recovered* n	(%)	Expired n	(%)	p value
Age (months)						
2-11	44	34	(77)	10	(23)	
^12	11	9	(82)	2	(18)	0.55
Nutritional status						
Normal	14	12	(86)	2	(14)	
Malnourished	41	31	(76)	10	(24)	0.35
Organism						
H. influenzae	28	23	(82)	5	(18)	
S. pneumoniae	15	10	(67)	5	(33)	0.02
Level of consciousness						
Normal	25	23	(92)	2	(8)	
Altered	30	20	(66)	10	(34)	0.02

*Includes partially recovered also.

cases had received prior antibiotics but this did not have a significant effect on the isolation of the organism by culture or the outcome. Kaplan and Shohet have reported that prior antibiotics do not alter CSF findings–cell count, morphology, sugar or protein nor do they change the percentage of positive cultures(16,17). Occasionally the CSF can be normal though organisms can be recovered by culture(18). Level of consciousness at the time of initiation of treatment is an important prognostic factor and our findings confirm the previous observations(12-14,19). CSF sugar >50% of blood level does not rule out BM as seen in 22% of our BM cases. Case fatality in our study is high (22%). This is similar to reports from developing countries, unlike that of developed countries(19,20). Most of the infections due to HiB and SP were seen under 18 months of age. This is similar to the reported findings(19). We had only one case of *N. meningitides.*

We found LAT test is very useful in arriving at the etiological diagnosis of BM rapidly. LAT gave a high positivity rate and the results are available in a very short time of 10 minutes. This would help the clinician to institute the appropriate treatment. But the test kits are expensive in developing countries.

We would like to conclude that identification of organisms by Gram stain is the cheapest to institute appropriate treatment immediately. If Gram stain is negative, it is recommended to use LAT as it gives results in a very short time for common organisms under 2 years of age.

Acknowledgement

The project was supported by the Indian Council of Medical Research. The authors thank the Director of Institute

of Child Health for permitting them to utilize the clinical material and carry out the study. They also acknowledge the help of the Microbiology Department for the laboratory services. The secretarial services rendered by Mrs. Ananthi are acknowledged.

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