Bacterial Meningitis Score as Clinical Prediction Rule in Children with Acute Meningitis

Km R[1], Shah GJ[2], Sah SN[1]

ABSTRACT

Introduction: The early presentation of bacterial meningitis and aseptic meningitis are similar however treatment and outcome are different. The Bacterial Meningitis Score helps to differentiate bacterial meningitis from aseptic meningitis. **Aims:** To evaluate bacterial meningitis score as clinical prediction rule in children with acute meningitis. **Methods:** This was a hospital based prospective study done at pediatric department of Nepalgunj Medical College, Nepalgunj, a tertiary care reference hospital in Nepal, conducted from September 2020- August 2021. All the patients who were suspected of meningitis during the study period between the ages of 29 days to 15 years were included in this study. **Results:** A total of 138 patients were included in our study with 86 patients as aseptic meningitis and 52 patients as bacterial meningitis. Taking cut-off point of bacterial meningitis scoreto be 1.5 it's sensitivity and specificity was found to be 100%. Area under ROC curve was found to be 1 showing 100% predictivity of bacterial meningitis score . The outcome of aseptic meningitis group was significantly better than bacterial group. **Conclusion:** Bacterial meningitis had grave prognosis associated with high mortality. Bacterial meningitis score is helpful to differentiate aseptic meningitis from bacterial meningitis to plan appropriate management timely.

***Keywords**:* Antibiotics, Bacterial Meningitis Score, CSF, Meningitis

Authors:

1. Dr. Roma Km
2. Mr. Gaurav Jung Shah
3. Dr. Shyam Nandan Sah

[1]Department of Pediatrics, Nepalgunj Medical College and Teaching Hospital, Nepalgunj, Banke, Nepal

[2]Department of Community Medicine, Nepalgunj Medical College Chisapani, Banke, Nepal

Address for Correspondence:

Dr. Roma Km
Associate Professor
Department of Pediatrics
Nepalgunj Medical College and Teaching Hospital
Nepalgunj, Banke, Nepal
Email: bora.roma@gmail.com

INTRODUCTION

Patients having cerebrospinal fluid (CSF) pleocytosis are routinely admitted to the hospital and treated with parenteral antibiotics despite the fact that all the patients do not turn out having bacterial meningitis on subsequent evaluation. On the other hand, bacterial meningitis (BM) can be a life-threatening emergency if proper diagnosis and management is not done in time and is associated with high mortality and morbidity in the form of neurologic sequelae.[1,2] Case fatality rates varies from 22%-73% in low and middle-income countries.[3,4] Etiologically meningitis is classified as aseptic and bacterial. Aseptic meningitis is a diagnosis of exclusion based on the lack of evidence of bacterial findings and is caused by viruses having lower case fatality rates. Annual incidence of BM is over 1.2 million cases across the globe.[5] Prevalence of bacterial meningitis is about 3.8% in Nepal.[6] Clinical differentiation of bacterial meningitis from aseptic or viral meningitis is difficult. For the diagnosis of bacterial meningitis, timely lumbar puncture (LP) before starting antibiotics is essential to identify bacteria or their markers.[7] Bacterial Meningitis Score (BMS) is a scoring system used to differentiate between viral and bacterial meningitis. Patients are considered to be at very low risk of bacterial meningitis if they do not have all of the following criteria: positive CSF Gram stain, CSF absolute neutrophil count (ANC) of at least 1000 cells/µL, CSF protein of at least 80 mg/dL, peripheral blood ANC of at least 10000 cells/µL and a history of seizure before or at the time of presentation.[8]

METHODS

This was a hospital based prospective study done at pediatric department of Nepalgunj Medical College, Nepalgunj, a tertiary care reference hospital in Nepal. This study was conducted from September 2020 - August 2021. All the patients who were suspected of meningitis during the study period between the ages of 29 days to 15 years were included in this study. CSF pleocytosis (CSF WBC ≥10 cells/mm3) or a positive CSF culture was defined as meningitis. Positive CSF culture for a bacterial organism or CSF pleocytosis (≥10 WBCs per mm^3) along with a positive blood culture for a bacterial pathogen was defined as bacterial meningitis. CSF pleocytosis with negative bacterial cultures of both the CSF and blood was considered to be having aseptic meningitis. Bacterial Meningitis Score(BMS) was used to differentiate bacterial meningitis from aseptic meningitis.

Inclusion criteria were children aged 29 days to 15 years were considered to have meningitis and included in the study if any of the following criteria met: CSF pleocytosis or a positive CSF culture whereas exclusion criteria were the patients who had received oral or parenteral antibiotics within 72 hours before their lumbar puncture. Patients with CSF pleocytosis requiring hospital admission including children with any of the following conditions or clinical findings: critical illness (severely altered mental status, evidence of cerebral herniation, need for respiratory or pressure support), purpura, presence of ventricular shunt device, recent neurosurgery, immunosuppression other bacterial infections requiring antibiotics (e.g. urinary tract infections in infants 3 months, periorbital cellulitis, deep abscess, bone / joint infections or known bacteremia) were excluded because antibiotic treatment alters CSF profiles causing false negative blood cultures, CSF cultures or both.

The statistical package program SPSS version 20 was used. All numerical variables were organized into categories for better interpretation. Chi-square were used for statistics analysis. P value less than 0.05 was regarded as statistical significance. Age obtained in days was converted into groups of neonates (1 to 29 days), infants (1 to 11 months), toddlers (1 to 5 years), children (6 to 10 years) and teenagers (11 to 15 years).

RESULTS

In total 138 patients who met inclusion criteria were included in our study. We enrolled 86 patients as aseptic meningitis and 52 patients as bacterial meningitis. Male to female ratio was 1.5:1 with male preponderance in both aseptic and bacterial group. Both bacterial meningitis and aseptic meningitis were more common in infants as supported by other studies. There was an excellent outcome with complete recovery in aseptic group but bacterial meningitis was found to be associated with significant morbidity and mortality i.e. 9.6% and 13.5% respectively which was found to be statistically significant (P<0.001)

Aseptic meningitis was more commonly seen in the months of July to September whereas there was no seasonal variation in bacterial meningitis. In aseptic meningitis more commonly observed clinical features were fever (96.5%), convulsions (93%) and poor appetite (82.5%) whereas children with bacterial meningitis group were presented with fever (98.1%), altered sensorium (96.1%) convulsions (94.2%). There was significant difference in laboratory data of both the groups as elaborated in table III.

Characteristics		Aseptic group	Bacterial group	P value
Sex	Female	37 (43%)	18 (34.6%)	0.020
	Male	49 (57%)	34 (65.4%)	
Age	1-11 months	34 (39.5%)	23 (44.2%)	0.744
	1-5 years	20 (23.2%)	13 (25%)	
	6-9 years	16 (18.6%)	10 (19.23%)	
	10-15 years	16 (18.6%)	6 (11.54%)	
Outcome	Complete recovery	86 (100.0%)	40 (76.9%)	<0.001
	Sequelae	0 (0.0%)	5 (9.6%)	
	Death	0 (0.0%)	7 (13.5%)	

Table I: Comparison of characteristics between aseptic and bacterial group

Symptoms and signs	Aseptic group	Bacterial group	P value
Fever	83 (96.5%)	51 (98.1%)	0.515
Headache	39 (45.3%)	22 (42.3%)	0.433
Poor appetite	71 (82.5%)	40 (76.9%)	0.276
Convulsion	80 (93.0%)	49 (94.2%)	0.541
Vomiting	41 (47.7%)	28 (53.8%)	0.299
Irritability	34 (39.5%)	37 (71.1%)	<0.001
Neck rigidity	14 (16.3%)	11 (21.1%)	0.308
Meningeal sign	4 (4.6%)	3 (5.8%)	0.531
Altered sensorium	4 (4.6%)	50 (96.1%)	<0.001
Bulging Fontanelle	1 (1.2%)	9 (17.3%)	0.001

Table II: Comparison of symptoms and signs between aseptic and bacterial group

Laboratory data	Aseptic group (mean)	Bacterial group (mean)	P value
CSF-WBC (cells/mm3)	97.5 (19.06)	190 (309.83)	<0.001
CSF- Lym (%)	34.5 (33.59)	5 (17.15)	<0.001
CSF- Neu (%)	18 (15.52)	90 (75)	<0.001
CSF- Protein (mg/dl)	50 (48.64)	220 (287.25)	<0.001
CSF- glucose (mg/dl)	60 (63.60)	38 (68.81)	0.001
Blood- glucose (mg/dl)	105.5 (102.41)	114 (111.13)	<0.001
CSF/blood-glucose	0.6 (0.6243)	0.4 (0.6231)	0.942
Blood-WBC (cells/mm3)	12300 (8692)	11500 (21374)	<0.001
Blood- Neu (%)	65 (35.48)	50 (84.98)	<0.001
Blood- Lym (%)	18.6 (54.15)	26 (25.90)	<0.001
Blood-CRP (mg/dl)	0.56 (2.394)	4.9 (21.462)	<0.001

Table III Comparison of laboratory data between aseptic and bacterial group

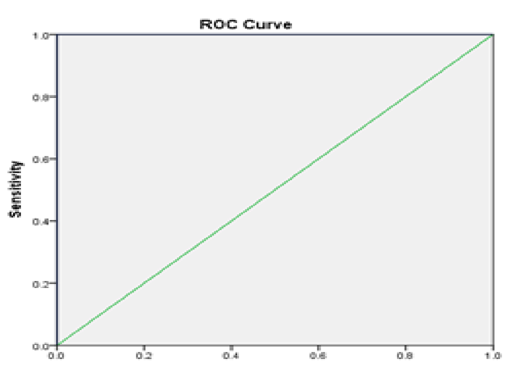

Figure 1: ROC curve for bacterial meningitis score area under curve = 1

Coordinates of the Curve		
BMS		
Positive if Greater Than or Equal To	Sensitivity	1 – Specificity
-1.00	1.000	1.000
1.50	1.000	.000
3.50	.942	.000
5.00	.000	.000

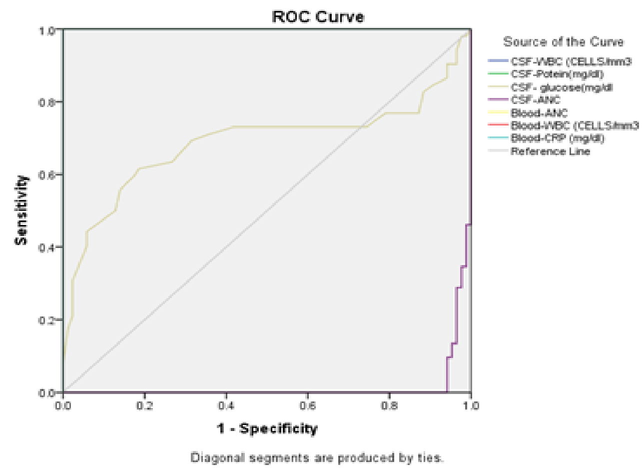

Figure 2: ROC curves for each of the continuous univariate candidate predictors: blood CRP, CSF protein, CSF ANC, CSF WBC count, blood WBC count, blood ANC and CSF glucose

Area Under the Curve	
Test Result Variable(s)	Area
CSF-WBC (CELLS/mm3)	1.000
CSF-Protein(mg/dl)	1.000
CSF- glucose(mg/dl)	.688
CSF-ANC	.015
Blood-ANC	1.000
Blood-WBC (CELLS/mm3)	1.000
Blood-CRP (mg/dl)	1.000

DISCUSSION

It is important to differentiate aseptic meningitis from bacterial meningitis for appropriate treatment and better outcome. Most of the patients with CSF pleocytosis have aseptic meningitis rather than bacterial meningitis who can be treated in outpatient department.[9] In our study both bacterial meningitis and aseptic meningitis ware more commonly seen in infants because their immune system is not well developed. In a study from Taiwan, it was found that bacterial meningitis occurs more frequently in less than 1 month of age which may be because of high immunization rate and good environmental sanitation preventing occurrence of bacterial meningitis in older children.[10] Aseptic meningitis was more commonly seen in months of July to September whereas there was no seasonal variation in bacterial meningitis. Few other studies differed in seasonal variation from our study.[11,12,13] Children with aseptic meningitis presented more frequently with fever and also had convulsion and poor appetite while altered sensorium along with fever and convulsion is more common with bacterial group, because bacterial meningitis is more common in younger age group reflecting the more severity of the disease. Similar clinical features were also found in a study done from Taiwan.[10]

In our study, there was lymphocytes predominance in aseptic meningitis over bacterial group which was similar to other studies.[14,15] In bacterial group polymorphonuclear predominance was observed which is supported by study of Long SS.[16] White blood cells count of CSF and C- reactive protein of plasma is a good marker to differentiate between bacterial and viral meningitis.[17] Ratio of CSF/ Blood-glucose has been shown to be the most accurate predictor of bacterial meningitis.[18] Significant difference was found in CSF-protein, CSF-glucose, CSF/ Blood-glucose ratio between aseptic and bacterial meningitis group in our study similar to the study done by Wang YJ et al.[10] Blood CRP was also found to be significantly different in both the groups as previously reported. Empirical antibiotics are a routine practice in suspected meningitis cases, causing antibiotic overuse. If a quick and precise diagnosis can be made, then antibiotic over use can be minimized. We used bacterial meningitis score as a clinical tool to differentiate between bacterial and aseptic meningitis. Taking cut-off point of BMS to be 1.5 it's sensitivity and specificity was found to be 100%. Area under ROC curve was found to be 1 showing 100% predictivity of bacterial meningitis score. This score was found to be accurate in differentiating the two as supported by other studies.[19, 20] By using bacterial meningitis score we can differentiate bacterial and aseptic meningitis to initiate proper management.

LIMITATIONS

The limitation of this study was that this study was a single center study conducted at a tertiary referral center on a small sample size with convenient sampling so for generalization of results a multicentric study on a larger sample should be done.

CONCLUSION

Bacterial meningitis had grave prognosis associated with high mortality. Bacterial meningitis score is helpful to differentiate aseptic meningitis from bacterial meningitis to plan appropriate management timely.

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