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Original Research Article

Quantitative C-reactive Protein Levels in Children with Bacterial and Other Meningitis in Cerebrospinal Fluid at Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar

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Abstract

Background: In both industrialised and developing nations, bacterial meningitis is a substantial cause of morbidity and mortality in children. Individuals with suspected bacterial meningitis require immediate medical attention, however there is a substantial risk of poor outcome due to delayed and inadequate diagnosis. It is possible to enhance the prognosis of an illness with an early and accurate diagnosis of the ailment.

Methods: From September 2021 to August 2022, the current study was carried out in the pediatrics department of Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar. To confirm the diagnosis, a total of 242 children who were admitted during the research period and had a clinical suspicion of meningitis underwent clinical, biochemical, cytological, and bacterial testing. Also, a quantitative amount of CSF was sent for C-reactive protein measurement using an immuno-turbidimetric latex agglutination test.

Results: Only 20 of the 242 meningitis cases brought to the hospital had a positive culture. The quantitative amount of CSF CRP differed significantly between bacterial and non-bacterial meningitis.

Conclusion: A useful test to distinguish pyogenic meningitis from tubercular meningitis, viral meningoencephalitis, and other non-meningitis CNS illnesses is the quantitative quantification of CRP in CSF by immunoturbidimetry. It is a simple, quick, accurate, and quick diagnostic test for prompt treatment action. The determination of CRP in CSF also influences the selection of the right antibiotic and the course of treatment.

Keywords: C-reactive Protein, CSF, Meningitis, Viral Meningoencephalitis.

Introduction

Leptomeninges, which are layers of the tissue that surround the brain and spinal cord, become inflamed when someone has meningitis. Infection with a microorganism, which might be bacterial, tubercular, viral, fungal, or protozoal, is a

major cause of meningitis. [1] Although it affects people of all ages, it is more likely to affect young children and newborns. [2] In order to effectively treat meningitis, it is crucial to distinguish between pyogenic (bacterial) and aseptic meningitis. Bacterial meningitis is a serious condition that can be fatal. It has an abrupt start and is characterised by fever, headache, altered awareness, stiff neck, and other symptoms of meningeal irritation. [3]

Meningitis is a serious issue in numerous parts of the world. It affects roughly 3 in 100,000 people in the US. In the UK, meningitis affects 2,500 people annually. More than 400 million individuals in 21 countries, from Senegal to Ethiopia, were afflicted by bacterial meningitis epidemics between 1995 and 2014 (African meningitis belt). [4] According to a study conducted from 2000 to 2011 in 12 nations (India, Bhutan, Bangladesh, Indonesia, Pakistan, North Korea, Maldives, Nepal, Myanmar, Sri Lanka, Timor-Leste, and Thailand), the incidence of meningitis varies by nation and ranges from 18.3 to 24.6 /105 inhabitants. [4,5]

The study of cerebrospinal fluid (CSF), which frequently exhibits an abnormal glucose level combined with a white blood cell (WBC) count and protein level, is necessary to make a conclusive diagnosis of meningitis. The acute phase protein known as C-reactive protein (C-RP) was first described in 1930 by Tillett *et al*. [6] C-reactive protein may be detectable in serum or other body fluids that are strongly linked to the damaged tissues in the majority of inflammatory disorders. [7,8] Several studies have demonstrated that C-reactive protein can distinguish between patients with bacterial and viral meningitis. [9] According to a meta-analysis, a negative C-reactive protein test in either serum or cerebrospinal fluid can be extremely helpful in excluding bacterial meningitis. [10-12]

On the other hand, relatively few research have looked into the diagnostic value of cerebrospinal fluid C-reactive protein to distinguish between bacterial and aseptic meningitis. [7,8] In contrast to 6% of individuals with aseptic meningitis, Corrall CJ et colleagues extrapolated that 100% of first lumbar puncture cerebrospinal fluid samples with culture-positive bacterial meningitis were positive for C-RP. The identification of bacterial meningitis with a culture-proven diagnosis was 100% sensitive and had a specificity of 94% for cerebrospinal fluid C-reactive protein. [13]

When compared to the number of cerebrospinal fluid glucose concentration, cerebrospinal fluid protein level, cerebrospinal fluid leukocytes, absolute cerebrospinal fluid polymorpho nuclear leukocytes, or Gram staining of cerebrospinal fluid, the initial cerebrospinal fluid C-reactive protein level was a much more sensitive parameter to distinguish between the two types of meningitis. [13]

The results of Patel *et al* uses of cerebrospinal fluid C- reactive protein as a fundamental tool to distinguish between bacterial meningitis and aseptic meningitis were positive, with sensitivity and specificity for Pyo-meningitis being 83.3% and 87.5%, respectively.

The study is aimed to estimate the level of CSF-CRP quantitatively in bacterial and other meningitis in among children admitted in Pediatric department of the ANMMCH, Gaya, Bihar.

Material and Methods

The estimation of quantitative CSF-CRP among children of meningitis is a hospital based descriptive cross sectional study. All aspects of this study have been accomplished in the department of Pediatrics, of the Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar from September 2021 to August 2022. 242 instances in total were chosen for this investigation. This study covered cases of meningitis in infants and children aged 1 day to 14 years who needed

a CSF investigation to confirm the diagnosis. Congenital CNS malformations, non-infectious CNS disorders, and infections at the lumbar puncture site were disregarded.

Using the Biosystems CRP kit, the immuno-turbidimetry approach was used to quantitatively measure CSF-CRP.

Group I: Pyogenic meningitis; Group II: Tubercular meningitis; Group III: Viral meningitis; and Group IV: No CNS infection. 242 meningoencephalitis patients between the ages of 1 day and 14 years were included in the study (Extra cranial infections).

Results

There were 56 cases in the control group, 104 cases of bacterial meningitis, 54 cases of viral meningoencephalitis, 26 cases of tubercular meningitis. The male to female ratios were 1.94:1, 5.5:1, 1.7:1, and 1.33:1 accordingly in the groups for acute bacterial meningitis, tubercular bacterial meningitis, viral meningocephalitis, and control. Males outnumbered females in every group.

Table 1: Distribution according to sex & diagnosis of patients

Diagnosis	Sex		Total
	Male n (%)	Female n (%)	n (%)
Acute Bacterial Meningitis	70 (66.03%)	36 (33.97%)	106 (100.0%)
Tubercular Bacterial Meningitis	22 (84.62%)	4 (15.38%)	26 (100.0%)
Viral Meningocephalitis	34 (62.97%)	20 (37.03%)	54 (100.0%)
Control Group	32 (57.15%)	24 (42.85%)	56 (100.0%)
Total	158 (65.29%)	84 (34.71)	242 (100.00)

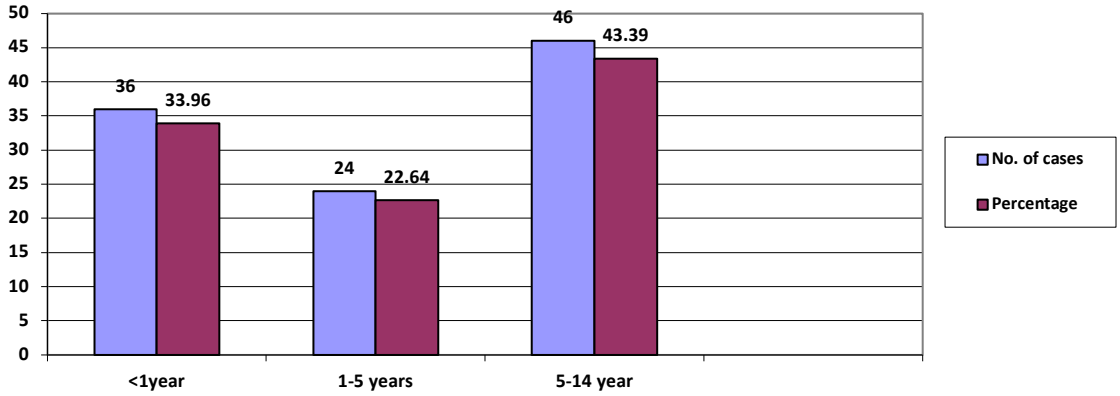

Figure 1: Distribution of pyogenic meningitis according to age group

In the current study, out of the 106 cases of pyogenic meningitis, 36 (33.96%) affected children under the age of one, 24 (22.64%) children between the ages of one and five, and 46 (43.39%) children between the ages of five and fourteen. Only 20 cases of bacterial meningitis had positive CSF cultures, while all other cases across all groups had negative cultures. (Figure 1)

In our study, 106 patients with bacterial meningitis made up 94 (88.67%) cases, and only 12 (11.32%) cases had quantitative CSF-CRP levels below 1000 ng/ml. In this sample, 38 instances (or 35.84%) had CSF-CRP levels greater than 2000ng/ml. In patients with tubercular meningitis, 22 (84.61%) out of 26 had quantitative CSF-CRP levels below 1000ng/ml, while only 4 had levels above 1000ng/ml. Among the 54 instances of viral

meningoencephalitis, 10 had CSF-CRP levels greater than 1000ng/ml, while the remaining 44 had levels less than 1000ng/ml.

Table 2: Distribution according to CSF CRP level & diagnosis of patients

CRP (ng/ml)	Diagnosis				Total n (%)
	ABM n(%)	TBM n(%)	VME n(%)	Control Group n (%)	
< 1000	12 (11.32%)	22 (84.61%)	44(81.48%)	50 (89.28%)	128 (52.89%)
1000-2000	56 (52.83%)	4 (15.38%)	10 (18.51%)	6 (10.71%)	76 (31.40%)
> 2000	38 (35.84%)	0 (0.00)	0 (0.00)	0 (0.00)	38 (15.70%)
Total	106 (100%)	26 (100%)	54 (100%)	56 (100%)	242 (100%)

In cases of bacterial meningitis, the mean CSF CRP was 1862 ng/ml, compared to 597 ng/ml in the control group, 992 ng/ml in cases of viral meningoencephalitis, and 816 ng/ml in cases of tubercular bacterial meningitis. Between the bacterial group and all other groups, there was a significantly significant difference in CSF CRP. (Table 3)

Table 3: Mean ±SD of CSF CRP according to diagnosis of subjects

Diagnosis	No.	Mean ±SD ng/ml
ABM	106	1862.20 ±812.19
TBM	26	816.00 ±361.55
VME	54	992.00 ±462.92
Control Group	56	597.20 ±301.38

Control Group v/s ABM	p <0 .001	Highly Significant	ABM v/s TBM	p <0.001	Highly Significant
Control Group v/s VME	p <0 .01	Significant	Control Group v/s TBM	p < 0.001	Highly Significant
ABM v/s VME	p <0 .01	Significant	TBM v/s VME	p > 0.05	Not Significant

Discussion

A potentially fatal condition, bacterial meningitis. Thus, early proper diagnosis and therapy are crucial. Pyogenic meningitis affects men more frequently (66%) than women. Gram's smear and CSF culture for pyogenic organisms could only identify 24% and 20% of patients, respectively, in the current investigation. In our investigation, the Biosystems CRP kit was utilised to measure CRP in CSF of suspected cases of meningitis utilising the IMMUNOTURBIDIMETRY technique. We investigated CRP's usefulness in the differential diagnosis of meningitis with various aetiologies. Our results revealed that the group with bacterial meningitis had considerably higher quantitative values of CSF CRP. A highly significant difference ($p<0.001$) existed between pyogenic meningitis and the control group, between pyogenic meningitis and viral meningoencephalitis, and between pyogenic meningitis and tubercular meningitis. Both the difference between viral meningo-encephalitis and the control group and the difference between tubercular meningitis and the control group were significant ($p<0.05$). But there was no statistically significant difference between viral meningo-encephalitis and tubercular meningitis ($p>0.05$). These results concurred with those of earlier studies by Donald PR *et al*, Gray BM *et al*, Hanson LO *et al*, Trienekens PH *et al*, Shimetani N *et al*, and Belal M *et al* [14-19].

Conclusion

Whilst the gold standard for diagnosing pyogenic meningitis in terms of direct proof of the organism is CSF culture, it has certain limitations, especially in peripheral settings. The routine use of CSF-C-reactive

protein detection may be a quick, simple, and reliable test to identify bacterial meningitis and distinguish it from aseptic meningitis. It is not a substitute for CSF biochemistry, cytology, or culture investigation.

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