The medical disease known as meningitis is defined by the inflammation of membranes that shield the brain and spinal cord. One of the most prevalent serious diseases in newborns and infants is meningitis. Aseptic meningitis is generally less severe than bacterial meningitis and often has a better prognosis.

CRP level is the most useful criterion for diagnosing feverish children with significant infections.

**Objective:**
The present study aimed to determine the level of CRP in CSF of bacterial meningitis, and aseptic meningitis for early prediction of meningitis and remove the lapse in its treatment.

**Methods:**
This cross-sectional study was conducted at the Immunology Department of The Children’s Hospital & the Institute of Child Health from Jan 2022 to Jan 2023. The present study enrolled patients who had meningitis symptoms (fever, headache, vomiting, and neck stiffness), aged between >2 years to 12 years, both male and female gender. The CRP levels of all patients were measured using the agglutination method. Data were analyzed using IBM-SPSS version 26.0.

**Results:**
Of the total 45 patients, 20 (44.4%) were males and 25 (55.6%) were females. The mean age of patients was 5.98+2.792 years. From total, 29 (64.4%) had bacterial meningitis while 16 (35.6%) had aseptic meningitis. The 09 (31.03%) bacterial meningitis patients had positive CRP (>3.0mg/L). The present study showed a statistically significant association between CSF-CRP results with bacterial and aseptic meningitis (p=0.003).

**Conclusions:**
While awaiting the results of other confirmatory tests, CSF-CRP can be utilized as an early diagnostic tool for the identification of bacterial and aseptic meningitis. Additionally, it could aid in the early diagnosis of aseptic vs bacterial meningitis.
account for almost half of the meningitis deaths that occur worldwide. If untreated, bacterial meningitis is lethal [3]. Between 5 to 20% children and 20 to 50% adults die every year with this condition [4]. Over time, the spectrum of organisms responsible for disease may change. The prognosis for bacterial meningitis has improved because of the availability of novel β-lactam antibiotics, vaccination against Haemophilus influenzae, pneumococci, and meningococci, better intensive care, and supportive therapy in developed countries [5]. These measures have also decreased the prevalence of bacterial meningitis. The main causes of childhood morbidity and death in developing countries are low vaccination rates, delayed seeking medical assistance, malnutrition, delayed diagnosis, and delayed starting proper antibiotic therapy in cases of bacterial meningitis [6]. Meningitis which is caused by viral infections as opposed to bacteria is known as aseptic meningitis. An inflammation of the meninges that results in pleocytosis of the cerebrospinal fluid, no growth on a standard bacterial culture, and a sudden onset of headache, fever, and stiff neck is known as aseptic meningitis. Common viruses that can cause aseptic meningitis include Enteroviruses, Herpesviruses, and the Mumps virus. Aseptic meningitis is generally less severe than bacterial meningitis and often has a better prognosis, as it tends to resolve on its own with supportive care [7-8].

C-reactive protein (CRP) is an acute-phase inflammatory protein. It has been included in screening tests for febrile children in recent decades [9]. Globally, CRP level is the most useful criterion for diagnosing feverish children with significant infections [10-11]. Due to many reasons, there is a delay in the diagnosis of meningitis patients. Because CSF culture sensitivity takes 48-72 hours for reporting which cause a delay in treatment.

The present study aimed to determine the level of CRP in CSF of bacterial meningitis, and aseptic meningitis for early prediction of meningitis and remove the lapse in its treatment.

M E T H O D S

The present cross-sectional study was conducted at the Immunology Department of The Children’s Hospital & the Institute of Child Health from January 2022 to January 2023, after getting ethical approval letter (Ref No.1459/SAHS dated 06 Dec 2021). The sample size of 45 children was calculated by taking positive bacterial meningitis children as 89%, taking 5% margin of error and 95% confidence interval [12]. The present study enrolled the patients who had meningitis symptoms (fever, headache, vomiting, and neck stiffness), aged between >2 years and up to 12 years, both male and female [13]. Patients of more than 12 years of age, and who had other types of brain infections (encephalitis/ brain tumors) were excluded. The lumbar puncture (LP) of suspected patients was performed by a neuro-physician. The CSF samples were received at the pathology laboratory for analysis. The physical examination, gram stain, protein, glucose, and cell count (total and differential leukocyte) were performed. Meningitis was classified as bacterial meningitis based on CSF examination results (increased protein >100 mg/dL, decreased glucose <40 mg/dL, and leukocyte count 100-5000/mm3 with polymorph nuclear leukocyte domination >80%), gram staining results, and/or positive bacterial culture. Conversely, viral meningitis was described as occurring when the bacterial culture was negative but the viral culture, serological tests, pleocytosis, or reverse transcriptase polymerase chain reactions were positive [14]. After the initial arrangements for diagnosis and treatment, and with informed consent about 05cc of blood was taken from each patient and transferred to the Pathology Laboratory. The samples were centrifuged at the speed of 3000 rpm for serum separation. Using the Dot Diagnostic Gmbh Germany Kit (Reference No. ASO/200607, Lot No. 200607), the CRP level of each patient was determined. The normal value of CRP was considered as <3.0mg/L. Data were analyzed using Statistical Package for the Social Sciences version 26.0 (IBM SPSS version 26.0). The quantitative variables were summarized as mean ± standard deviation while the qualitative variables were expressed as frequency and percentages. A chi-square test/Fisher’s exact test was performed to evaluate the association between variables.

R E S U L T S

In table 1, out of the total 45 patients, 20 (44.4%) were males and 25 (55.6%) were females. The patients had the ages between 02 years to 12 years old. The mean age of patients was 5.98±2.792 years. According to the CSF examination results, the patients were classified into bacterial meningitis and aseptic meningitis. From total, 29 (64.4%) patients had bacterial meningitis while 16 (35.6%) had aseptic meningitis.

Table 1: Demographic and Clinical Characteristics of Study Patients

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (Y)</td>
<td>5.98±2.792</td>
</tr>
<tr>
<td><strong>Age groups</strong></td>
<td></td>
</tr>
<tr>
<td>02 - 06 (Y)</td>
<td>27 (60.0%)</td>
</tr>
<tr>
<td>07 - 12 (Y)</td>
<td>18 (40.0%)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>20 (44.4%)</td>
</tr>
<tr>
<td>Female</td>
<td>25 (55.6%)</td>
</tr>
<tr>
<td><strong>Types of meningitis</strong></td>
<td></td>
</tr>
<tr>
<td>Bacterial meningitis</td>
<td>29 (64.4%)</td>
</tr>
<tr>
<td>Aseptic meningitis</td>
<td>16 (35.6%)</td>
</tr>
</tbody>
</table>

In figure1, out of a total of 29 bacterial meningitis patients, 13 (44.82%) were males and 16 (55.17%) were females, while 16 aseptic meningitis patients, 07 (43.75%) were males and 09 (56.25%) were females.
In addition to being a frequent and dangerous infection in infancy and childhood, bacterial meningitis is a major contributor to child mortality and morbidity [15]. To prevent this, it is essential to identify the condition early and start treatment with a suitable drug [16]. In a nation with few resources like Pakistan, where it can be challenging and time-consuming to isolate organisms appropriately, a simple, fast, affordable, and accurate test is required. The present study was conducted to estimate the values of CSF-CRP in bacterial and aseptic meningitis patients. According to this study, CSF-CRP may be used in situations when it is challenging to isolate microbes. The findings from this hospital-based study showed that the age group most vulnerable to acute bacterial meningitis was young children. Most of the patients (60.0%) belonged to the 02-06 years of age group and were affected with bacterial meningitis. A study by Rahman et al., also showed similar results [17]. The present study had a female preponderance (55.6%). The results of Bhatta et al., study showed the male preponderance of meningitis patients [18]. The difference in results may be due to the population, and geographical differences. The study patients were mostly infected with bacterial meningitis (64.4%) as compared to aseptic meningitis (35.6%). The study conducted by Rahman et al., enrolled 100 patients and showed that most patients were infected with bacterial meningitis (57.0%) [16]. Another cohort study conducted by Mintegi et al., concluded that more patients were infected with aseptic meningitis (88.86%) [11]. In the present study, (68.96%) bacterial meningitis and all aseptic meningitis patients had negative CRP (<3.0mg/L) while the 09 (31.03%) bacterial meningitis patients had positive CRP (>3.0mg/L). The study by Rahman et al., showed that (89.47%) of patients of bacterial meningitis, and 04 (6.97%) patients of aseptic meningitis had positive CSF-CRP [17]. According to Jadavinia et al., patients with bacterial meningitis had statistically significantly greater levels of CRP in their CSF than those with aseptic meningitis. CRP value was 0.95±0.68 mg/L in septic and 0.16±0.36 mg/L in aseptic with statistically significant p<0.001 [19]. As per Jabir PM et al., the mean CSF CRP values in cases of viral and bacterial meningitis were 3.16 and 4.44. They concluded that there was no difference (p=0.39) in the mean CSF CRP levels between viral and bacterial meningitis [20]. The present study shows a statistically significant association between CSF-CRP results with bacterial and aseptic meningitis (p=0.003). The overall mean value of CSF-CRP was 2.216 + 1.697. The mean value of CSF-CRP of bacterial meningitis was 2.697 + 1.9390, while the mean value of CSF-CRP of aseptic meningitis was 1.344 + 0.4211. According to Panji M et al., the mean CRP of CSF was 55.22 ± 3.11 mg/L for bacterial meningitis and 7.5 ± 1.18 mg/L for aseptic meningitis. They also reported a statistically significant
association (p=0.001) between CRP and meningitis [21]. The agglutination technique was used in this study to measure the CSF-CRP. Improved laboratory facilities might reduce the study’s limitations by enabling the detection of hs-CRP concentrations in CSF samples.

**CONCLUSIONS**

The present study concluded that the CSF-CRP is associated with bacterial and aseptic meningitis. While awaiting the results of other confirmation tests, it can be utilized as an early diagnostic tool for the diagnosis of bacterial and aseptic meningitis. The current study also found that, in contrast to aseptic meningitis, bacterial meningitis had a considerably higher CSF-CRP level. Therefore, it could also aid in the early diagnosis of aseptic vs. bacterial meningitis.

**Authors Contribution**

Conceptualization: UA, RSATK
Methodology: FA, MN
Formal analysis: UA, SP
Writing-review and editing: FA, OSKR, AR

All authors have read and agreed to the published version of the manuscript.

**Conflicts of Interest**

The authors declare no conflict of interest.

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**REFERENCES**


