BACTERIAL MENINGITIS IN CHILDREN

Irshad Ahmad, Ihsan-ul-Haq, Habib-ur-Rehman,
Asmat Ara Khattak, Faiz Mohammad Khan

Department of Paediatrics
Khyber Teaching Hospital, Peshawar,
Lady Reading Hospital, Peshawar and
Hayat Abad Medical Complex, Peshawar.

ABSTRACT

Objective: To study the demographic features, yield of gram staining, cerebrospinal fluid culture and etiological pattern of bacterial meningitis in children of 2 months to 12 years.

Material and Methods: A hospital based prospective and descriptive study was carried out at the Department of Pediatrics, Postgraduate Medical Institute, Lady Reading Hospital, Peshawar. All those children in the age group between 2 months to 12 years having clinical suspicion of meningitis and cerebrospinal findings suggestive of meningitis i.e. >10×10⁶ WBC/L and/or CSF sugar <40mg% or (<50% of the circulating blood sugar) and/or CSF protein >80mg% were included in the study. Children having history of intake of antibiotic in the last 5 days which can cross the blood brain barrier and children with tuberculous meningitis were excluded.

Results: A total of 120 patients (1.7% of the total admissions) were included in the study. Male patients were 69 (57.5%) and female were 51 (42.5%). Out of 120, 47(39.2%) were in the age group of 2 months-1 year, 39 (32.5%) were in the age group of >1-5years and 34 (26.3%) were in the age group of >5-12years. Majority of our children were below 5 years i.e. 71.7%. Gram staining was positive in 68(56.7%) cases and negative in 52(43.3%). The CSF cultures were positive in 59(49.2%) cases and negative in 61(50.8%). The three most common pathogens isolated were Streptococcus Pneumoniae 27(22.5%) cases, Neisseriae Meningitides 20(16.7%) cases and Hemophilus influenzae B 11(9.2%) cases.

Conclusion: Bacterial meningitis is the major cause of morbidity in children below the age of 5 years. The yield of gram staining and culture though comparable with the national studies but lower than reported internationally. S Pneumoniae, N Meningitides and H Influenzae are the three most common causes of Bacterial Meningitis in our children as reported nationally and internationally.
Key words: Bacterial meningitis, Cerebrospinal fluid gram staining, Cerebrospinal fluid culture.

INTRODUCTION

Bacterial meningitis is one of the most common serious infections of childhood. It is the major cause of morbidity and mortality in pediatric age group. Timely diagnosis and management with appropriate and the adequate antibiotics is of utmost importance to prevent mortality and long term morbidity. World wise two third of the cases of meningitis occur below the age of 15 years. So the major burden of this disease is being shared by the pediatricians. In the pediatric age group, more than 75% of the cases occur below the age of 5 and of these, 50% of the cases occur below the age of 2 years. More than 75% cases are caused by the three pathogens i.e. hemophilus influenzae B (HIB), streptococcus pneumonieae and neisseriae meningitides. Hemophilus is responsible for more than 50% of the cases. In the developed world its incidence is on the decrease because of universal immunization against hemophilus influenzae b infection. The mean age of hemophilus influenzae B infection in 1985 in the USA was 15 months, which has increased to 25 years in 1995 due to the immunization program against hemophilus influenzae b.

This study was conducted to study the demographic features, yield of gram staining, cerebrospinal fluid culture and etiological pattern of bacterial meningitis in children between 2 months to 12 years admitted to our unit.

MATERIAL AND METHODS

This study was carried out at the department of Pediatrics, Postgraduate Medical Institute, Lady Reading Hospital, Peshawar. Total duration was one year from October, 1999 to September, 2000.

All those children in the age group between 2 months to 12 years having clinical suspicion of meningitis and cerebrospinal findings suggestive of meningitis i.e. >10×10^6 WBC/L and/or CSF sugar <40 mg% or (<50% of the circulating blood sugar) and/or CSF protein >80 mg% were included in the study.

Children with history of intake of any antibiotics in the last five days that can cross the blood brain barrier and affect the cerebrospinal fluid findings, having age less than 2 months and more than 12 years or having tuberculous meningitis were excluded. Those children who had a preexisting neurological or developmental abnormality or meningitis due to head trauma or CSF shunt operation were also excluded.

This was a descriptive study. Those patients, who fulfilled our criteria, were enrolled after informed consent. A detailed history and examination was done of every patient and all the findings were recorded on a standard proforma. Lumber puncture was done immediately upon arrival of the patient to the hospital and cerebrospinal fluid was sent to the laboratory before giving the first shot of antibiotics. Cerebrospinal fluid’s biochemistry (i.e. CSF glucose and proteins levels), microscopy (total WBC count with differential counts), gram staining and culture studies were done on all patients. Other supportive investigations like Hb, TLC, DLC, chest x-rays, diagnostic BCG, serum electrolytes, PT/APTT, blood urea, serum creatinine, LFT’s, gram staining of the skin
lesions, skull ultrasound and CT brain were also done when required.

A daily progress report was maintained for each patient and findings by a Senior Pediatrician were recorded. All the patients were observed for a minimum period of 7 days.

**RESULTS**

During this study period, a total of 7148 patients were admitted to the department of pediatrics, Postgraduate Medical Institute Lady Reading Hospital, Peshawar. Total numbers of patients enrolled were 145. Of the total enrolled, 25 patients left the hospital before the minimum observation period of 7 days and were not included. Total numbers of patients studied were 120.

Total admissions during the study period (N) = 7148
Total number of patients enrolled = 145
Total number of patients studied (n) = 120 (1.7% of the total Admissions).

Drop outs = 25 (17.2% of the total enrolled)

**Sex Distribution**

Out of 120, 69 (57.5%) were male and 51 (42.5%) were female (Table no.1).

**Age Distribution**

Majority of our children were below 5 years i.e. 71.7% (Table no.2).

**SEX DISTRIBUTION**

<table>
<thead>
<tr>
<th>Sex</th>
<th>No. of Patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>69</td>
<td>57.5</td>
</tr>
<tr>
<td>Female</td>
<td>51</td>
<td>42.5</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td>100</td>
</tr>
</tbody>
</table>

**TABLE-1**

**AGE DISTRIBUTION**

<table>
<thead>
<tr>
<th>Age</th>
<th>No. of Patients</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 months - 1 year</td>
<td>47</td>
<td>39.2</td>
</tr>
<tr>
<td>&gt;1 - 5 years</td>
<td>39</td>
<td>32.5</td>
</tr>
<tr>
<td>&gt;5 - 12 years</td>
<td>34</td>
<td>28.3</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td>100</td>
</tr>
</tbody>
</table>

**TABLE-2**

**Gram Staining Results**

Gram staining was positive in 68 cases and negative in 52 (Table no. 3).

**GRAM STAINING RESULTS**

<table>
<thead>
<tr>
<th>Total</th>
<th>Gram Staining +ve</th>
<th>Gram Staining +ve</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 (100%)</td>
<td>68 (56.7%)</td>
<td>52 (43.3%)</td>
</tr>
</tbody>
</table>

**TABLE-3**

**Cerebrospinal Fluid Culture Results**

The CSF cultures were positive in 59 cases and negative in 61 (Table no. 4).

**CEREBROSPINAL FLUID CULTURE RESULTS**

<table>
<thead>
<tr>
<th>Total</th>
<th>Culture Positive</th>
<th>Culture Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 (100%)</td>
<td>59 (49.2%)</td>
<td>61 (50.8%)</td>
</tr>
</tbody>
</table>

**TABLE-4**

**Etiological Pattern of CSF Culture**

The three most common pathogens isolated were Streptococcus Pneumoniae (27 cases), followed by Neisseria Meningiides (20 cases) and Hemophilus influenzae B (11 cases) (table no. 5).

**DISCUSSION**

In our hospital, meningitis is responsible for 3-5% of pediatric admissions. Most of the
time this diagnosis is based on clinical grounds i.e. clinical examination and cerebrospinal fluid microscopy, biochemical examination and gram staining. But even the gram staining results are positive in a minority of the cases. Because majority of the children do receive antibiotics in one form or the other before reaching the hospital\(^\text{10,11,12,13,14}\). The recent conflicting reports regarding the classic CSF findings of septic meningitis in cases of viral meningitis has made gram staining and culture studies more important\(^\text{8,9,10}\). CSF culture is the “gold standard” and should always be obtained when possible\(^\text{8}\). In our hospital this is usually not possible because round the clock facility for CSF culture is not available.

The male predominance in this study is similar to other studies from Pakistan and abroad\(^\text{10,11,12,13,14}\). Majority of our patients were younger than 5 years i.e. 71.7%. But the percentage of <1 year of age (39.2%) is lower in this study as compare to other studies from Pakistan like Akbani et al\(^\text{10}\) (50%), Qazi et al\(^\text{15}\) (55%), Butta et al\(^\text{16}\) (61%) and Soomro et al\(^\text{17}\) (63.4%). This lower percentage is expected as the symptoms and signs of meningitis are subtler in this age group and most of them get antibiotics before they reach the hospital. In the developed world there is considerable decline in the incidence of bacterial meningitis in the older children. Bonadio et al\(^\text{18}\) reported 4% of the children >5 years, while in our study 26.3% were above 5 years which is a big deference and a matter of concern.

The yield of stainable organisms from CSF smear in Europe and USA\(^\text{19,20}\) is almost 80%. In our study, the gram stain smear positivity rate (56.7%) is much lower than the developed countries. However our results are comparable to the studies from Pakistan (table no. 6). We believe that close liaison between the laboratory staff and clinician can further improve the yield of gram staining as most of the time in our hospital, the CSF is sent for microscopy after the patient receives first few doses of antibiotics inside the hospital, which make yield of gram staining almost impossible even though

### Table 5

<table>
<thead>
<tr>
<th>Name of Organisms</th>
<th>No. of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>S Pneumoniae</td>
<td>27</td>
<td>22.5</td>
</tr>
<tr>
<td>N Meningitides</td>
<td>20</td>
<td>16.7</td>
</tr>
<tr>
<td>H Influenza B</td>
<td>11</td>
<td>09.2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>01</td>
<td>00.8</td>
</tr>
<tr>
<td>Unidentified</td>
<td>61</td>
<td>50.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>120</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

### Table 7

<table>
<thead>
<tr>
<th>Study Name</th>
<th>Culture Positivity Rate</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akbani et al</td>
<td>57.1%</td>
<td>1988</td>
</tr>
<tr>
<td>Soomro et al</td>
<td>46.3%</td>
<td>1995</td>
</tr>
<tr>
<td>Akund et al</td>
<td>51.8%</td>
<td>1991</td>
</tr>
<tr>
<td>Qazi et al</td>
<td>46.3%</td>
<td>1996</td>
</tr>
<tr>
<td>Angio CT et. al.</td>
<td>90.8%</td>
<td>1995</td>
</tr>
<tr>
<td>Ladien et al</td>
<td>80.5%</td>
<td>1997</td>
</tr>
<tr>
<td><strong>This study</strong></td>
<td><strong>56.7%</strong></td>
<td><strong>2000</strong></td>
</tr>
</tbody>
</table>

### Table 6

<table>
<thead>
<tr>
<th>Study Name</th>
<th>Gram Positivity Rate</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akbani et al</td>
<td>62.1%</td>
<td>1988</td>
</tr>
<tr>
<td>Soomro et al</td>
<td>63.4%</td>
<td>1995</td>
</tr>
<tr>
<td>Spanos et al</td>
<td>71.0%</td>
<td>1989</td>
</tr>
<tr>
<td>Ladien et al</td>
<td>80.5%</td>
<td>1997</td>
</tr>
<tr>
<td><strong>This study</strong></td>
<td><strong>56.7%</strong></td>
<td><strong>2000</strong></td>
</tr>
</tbody>
</table>
there may not be a history of prior antibiotics intake.

CSF cultures were positive in 49.2% of the cases in this study, which is comparable to other studies from Pakistan (table no 7). However, the culture positivity rate in our study is much lower than that reported internationally\(^2,3,22\). Again, we believe that this lower yield of culture can be improved by a close liaison between the clinical and the laboratory staff and round the clock facility of CSF culture in our hospital.

The percentage isolation of the three most common pathogens i.e. S pneumoniae, N meningitides and hemophilus influenzae B (HIB) in this study is similar to the studies from Pakistan. The relative incidence of HIB in this study is lower than expected (>50% in the developing world). We believe that HIB is more common in younger children and the signs & symptoms of meningitis are subtler in this age group. So, majority of them gets antibiotics before reaching the hospital and so were excluded from the study because of our inclusion criteria. However, the relative incidence of H. influenzae b is much higher than reported internationally\(^2,3,21\). The reason is adoption of routine immunization against H. influenzae B in these countries. This also demonstrates the need of inclusion of hemophilus influenzae B vaccine in our Expanded Immunization program (EPI).

LIMITATIONS OF OUR STUDY

This study had several limitations. We were unable to do blood culture along with CSF culture, as at times blood culture is positive when CSF culture is negative. We were unable to do viral cultures on those patients in whom gram staining and cultures were negative as viral meningitis may at times present exactly like bacterial meningitis. The main limitation of such investigations was the high cost and lack of facilities in our hospital.

CONCLUSIONS

- Bacterial Meningitis is still a very common serious infection in our children in all age groups.
- S pneumoniae, N meningitides and H influenzae are the three most common causes of bacterial meningitis in our children as reported nationally and internationally.
- The yield of gram staining and culture though comparable with the national studies but lower than reported internationally.

RECOMMENDATIONS

- There should be a close liaison between the clinical and laboratory staff and more attention should be given to the gram-staining smear.
- Round the clock facility for CSF cultures should be available inside the hospital.
- H. influenzae b vaccine should be added to the routine immunization program in our country.

ACKNOWLEDGMENTS

We are thankful to Prof. Liaquat Ali, the microbiologist and the staff of City Medical Laboratory for providing the facility of doing round the clock cerebrospinal fluid cultures. We are also very thankful to the Bosch Pharmaceuticals for sponsoring this study.

REFERENCES

3. Haslan RHA: Neurologic evaluation. In Behrman E, Kleigman F (eds); Nelson
15. Qazi SA, Khan MA, Mughal N. et al: Dexamethasone and Bacterial meningitis in Pakistan; Arch Dis child 1996; 75: 484-487.

Address for Correspondence:
Dr. Irshad Ahmed,
Assistant Professor Pediatrics,
Department of Child Health,
Khyber Teaching Hospital,
Peshawar.
Email: dirshad007@yahoo.com