Ethiology of Bacterial Meningitis in Children in Tuzla Canton

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1. INTRODUCTION

Meningitis is an inflammation of the meninges, the membranes surrounding the brain and spinal cord (1). This is one of the most serious infectious diseases in childhood, which is also now days a significant cause of morbidity and mortality (2). It is principally a disease of early childhood with more than 50 per cent of cases occurring in children less than five years of age (3).

The three most common bacterial pathogens causing bacterial meningitis are Haemophilus influenzae type b (Hib), Neisseria meningitis, and Streptococcus pneumoniae, which together account for more than 75% of all cases (4). Before the widespread use of Hib conjugate vaccines, approximately 70% of cases of bacterial meningitis among children younger than 5 years were due to Hib and the routine use of Hib conjugate vaccine has lead to a 94% reduction in the number of cases of Hib meningitis (5). Streptococcus pneumoniae is the most common cause of bacterial meningitis in countries where vaccination against Hib is introduced, and most cases of bacterial meningitis caused by Streptococcus pneumoniae occurs during the first two years of life, then number declines during late childhood and then again increases with age (7).

Bacterial meningitis usually occurs sporadically, although outbreaks are possible, especially when it comes to meningococcal meningitis (8). Transmission occurs via close contact or respiratory droplet spread (9).

The annual incidence of bacterial meningitis is 2-3 per 100,000 people, with peaks in infancy and adolescence (9). The incidence varies depending on age, gender, race, season and the immune status of patients (10). Studies around the world have shown that male children are often more affected than female children, with a male to female ratio 1.5:1, and there is a seasonal trend with most cases of bacterial meningitis occurring during autumn and winter (11).

In children mortality rate ranges from 2%, even up to 30% in infants (12).
of cerebrospinal fluid or blood. From the study were also excluded children with proven meningitis whose cause was Mycobacterium tuberculosis.

In this study we have used medical records, and analyzed all the information about signs and symptoms suggestive of an infection of the central nervous system (fever, vomiting, headache, photophobia, food refusal, sleeplessness, irritability, crying, altered state of consciousness, seizures, petechial rash, bulged fontanel, positive meningeal signs (neck stiffness, Kerning sign, Brudzinski sign), and biochemical and microbiological findings of cerebrospinal fluid (CSF).

Biochemical findings CSF in bacterial meningitis are: number of white blood cells in CSF > 1000/ml; Glucose level < 2.2 mmol/l (usually reduced by more than 50% of blood glucose values); Total proteins >1 g/l.

Microbiological analysis of CSF and blood was performed at the Institute of Microbiology Tuzla, using appropriate microbiological methods (CSF and blood cultures).

**Statistical analysis**

Continuous variables were compared by the Student t test and categorical variables with χ² or Fisher exact tests. A 2-tailed p value < 0.05 was considered significant. All statistical analysis was performed with SPSS version 17.0 (SPSS Inc, Chicago, IL, USA).

3. RESULTS

Over the ten year study period, from 05.01.1999 to 30.06.2009, a total of 140 registered patients 1 month to 14 years of age, were treated from bacterial meningitis in the Clinic for Infectious Diseases Tuzla. The patients came from the whole Tuzla Canton.

Average number of bacterial meningitis cases per year was 14. The incidence of bacterial meningitis cases, with respect to the year in which they were detected is shown in Figure 1. In 2003 highest number of new cases of bacterial meningitis was registered (15%). The same graph shows the trend line, shown as a three-year moving average, which shows the trend of declining incidence of bacterial meningitis followed by the end of the period.

The average age of patients with bacterial meningitis was 3.6 ± 3.8 years. Male to female ratio was 1.3:1.

Patients with bacterial meningitis were divided into five age groups: 1-12 months 54 (38.6%), 13-24 months 20 (14.3%), 2-5 years 29 (20.7%), 6-10 years 24 (17.1%) and 11-14 years 13 (9.3%) (Fig. 2). The largest number of cases with bacterial meningitis was in the age group of 1-12 months 54 (38.6%) and lowest in the group of 11-14 years 13 (9.3%), which was statistically significant (p < 0.001).

We analyzed frequency of detected cases with respect to seasons, and it was found that the largest number of cases 46 (32.9%) were in spring (March, April, May—Figure 3).

The CSF culture from the total of 140 patients with bacterial meningitis, were positive for one of the causative agents in 49 (35%) cases. When it comes to blood culture, it was found 5 (3.6%) patients with positive blood culture. Total of 2 (1.4%) patients had positive microbiological findings of both CSF and blood cultures.

Frequency of the most common causes isolated from cerebrospinal fluid is shown in Table 1. As can be seen, Haemophilus influenzae, Neisseria meningitidis and Streptococcus pneumoniae were the most frequently isolated pathogens from CSF (p<0.001).

If only the cases with positive CSF culture were counted, 49 of them, then the number of Haemophilus influenzae cases is 19 (38.8%), Neisseria menin-
Bacterial meningitis is a serious infectious disease. It can occur in all age groups but it is most common in children. Before antibiotic usage bacterial meningitis mortality rate was very high, up to 50%, but due to antibiotic therapy it is now much lower, while in underdeveloped countries it is still up to 30%. Also, the incidence of bacterial meningitis in children in the last 10-20 years was reduced, thanks to the introduction of vaccines against Hib and vaccination against Neisseria meningitidis.

Over the ten year study period, from May 1999 to June 2009, at The Clinic for Infectious Diseases in Tuzla, were 140 children age 1 month to 14 years treated for bacterial meningitis. This represents an annual average of 14 cases of bacterial meningitis. The largest number of cases of bacterial meningitis was recorded in the age group of 1-12 months 54 (38.6%), and lowest in the group 11-14 years of age 13 (9.3%), which was statistically significant. This information is important, because we need to pay attention to the patients in this age group, when we work at emergency-room and we need to diagnose bacterial meningitis quickly.

Figure 4 shows the distribution of pathogens from blood culture. Figure 4Distribution of pathogens of bacterial meningitis by age groups.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>No. (N)</th>
<th>Per. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candida albicans</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Haemophilus influenzae</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Coagulase negative Staphylococcus</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Neisseria meningitides</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Salmonella enteritidis</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Without isolated pathogen</td>
<td>135</td>
<td>96.4</td>
</tr>
<tr>
<td>Total</td>
<td>140</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The most cases of bacterial meningitis occurred during the winter and early spring (15). In our country the greatest number of patients with bacterial meningitis was in the spring, 46 (32.9%), but also during other seasons occurrence of bacterial meningitis has been pretty evenly distributed (summer 25%, 23% fall, and winter 19%). In a study in Egypt occurrence of bacterial meningitis in the seasons was as follows: in the fall of 35.1%, 48.5% of the winter, 5.4% in spring and 11.0% in summer (16).

4. DISCUSSION

Bacterial meningitis is a serious infectious disease. Before antibiotic usage bacterial meningitis mortality rate was very high, up to 50%, but due to antibiotic therapy it is now much lower, while in underdeveloped countries it is still up to 30%. Also, the incidence of bacterial meningitis in children in the last 10-20 years was reduced, thanks to the introduction of vaccines against Hib and vaccination against Neisseria meningitidis.

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Distribution of patients according to gender, male to female, was 1.3:1. The number of male children who suffered from bacterial meningitis was higher than female children. In a similar study in Oman distribution by gender showed ratio male children: female children – 1.4:1 (13). This result is similar to the results in our study. The average age of patients was 3.6 ± 3.8 years. In the French prospective study in which participated 1084 children with bacterial meningitis, mean age was 3.5 ± 4.38 (14).

The most cases of bacterial meningitis, 15% of the total number, were detected in 2003. Since 2003 there is a trend of declining number of cases of bacterial meningitis among children. April, May and November are the months when it was recorded the largest number of patients with bacterial meningitis, 54 (38.6%), which was statistically significant. Most cases of bacterial meningitis occurred during the winter and early spring (15). In our country the greatest number of patients with bacterial meningitis was in the spring, 46 (32.9%), but also during other seasons occurrence of bacterial meningitis has been pretty evenly distributed (summer 25%, 23% fall, and winter 19%). In a study in Egypt occurrence of bacterial meningitis in the seasons was as follows: in the fall of 35.1%, 48.5% of the winter, 5.4% in spring and 11.0% in summer (16).

Of 140 patients, from 49 (35%) of them it was isolated a pathogen from CSF, pathogen was isolated from blood cultures in 5 (3.6%) cases and in 2 (1.4%) cases were pathogen isolated both from CSF and from blood cultures. One study from Jordan, which included 50 children aged 2 months to 14 years, showed a positive CSF in 11 (22%) cases (17). Another study from Libya has presented a positive CSF culture in 62.3% of cases (18). All these children had clinical and laboratory characteristics that indicated that it is bacterial meningitis, but due to various factors such as the use of antibiotics before the lumbar puncture, the refusal of parents to perform a lumbar puncture, and deficiencies in the laboratory for isolating the pathogen, prevented the determination of etiology of the cause of bacterial meningitis (19).

The most common pathogens isolated from CSF were: Haemophilus influenzae 19 (13.6%), Neisseria meningitidis 12 (8.6%) and Streptococcus pneumoniae 8 (5.7%). This was statistically significant. If we count only the cases where we had positive CSF, 49 of them, then the percentage of isolated pathogens is as follows: Haemophilus influenzae, 19 (38.8%), 12 Neisseria meningitidis (24.5%) and Streptococcus pneumoniae 8 (16.3%). In a study from Spain in 51 cases of bacterial meningitis in children younger than 15 years in 33.3% of cases Haemophilus influenzae was isolated from CSF, in 49.0% cases Neisseria meningitides and in 17.7% cases Streptococcus pneumoniae has been isolated (20). In a similar study in Kuwait, from 110 children with bacterial meningitis under the age of 12 years were the following isolates: Haemophilus influen-
enzae in 44.3% cases, Streptococcus pneumoniae in 20.9% cases and Neisseria meningitidis in 12.7% of cases (21). Data obtained in this study are similar to data in other countries.

As for the distribution of causes of bacterial meningitis by age group, Haemophilus influenzae was the most common cause of bacterial meningitis in the age groups 1-12 months, (11 of 23 isolates) and 13-24 months (5 of 8 isolates), which was statistically significant. Also Neisseria meningitidis is a common cause in these age groups. In the age group of 2-5 years, the most common causative agent was Haemophilus influenzae, Neisseria meningitidis and then, in the age group of 6-10 years and 11-14 years the most common causative agent was Streptococcus pneumoniae.

Mortality rate in this study was 2.14%. In a similar study in Oman mortality rate was 2% (13). The mortality rate among children with bacterial meningitis in industrialized countries like the USA, is about 2.6% (22). High mortality rates have been reported in some developing countries and countries in the Middle East such as Turkey 38% (23). In Saudi Arabia mortality was 14.7% (24). In Sudan mortality was 28.6% (25). In India mortality rate was 21.8% (26). So we are among the countries with low mortality rate from bacterial meningitis.

5. CONCLUSION
Bacterial meningitis is present in the Tuzla Canton. Bacterial meningitis affects more male children and children 1-12 months of age. Spring is the period when it was registered the highest number of patients with bacterial meningitis. The most common causes of bacterial meningitis in children 1 month to 14 years of age were: Haemophilus influenzae, Neisseria meningitidis and Streptococcus pneumoniae. Haemophilus influenzae is the most common cause of bacterial meningitis in children 1-24 months of age.

REFERENCES