ORIGINAL ARTICLE

Acute Bacterial Meningitis in Infants and Children.

by

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Abstract

A study of acute bacterial meningitis in infants and children had been reported. Of particular interest in this study was the fact that the results of the CSF cultures revealed the most frequent causative agent to be Diplococcus pneumoniae (35%), with Staphylococcus aureus ranking second (25%). Other causative agents were E. coli (10%), Salmonella paratyphi B (10%), Streptococcus pyogenes (5%). Hemophilus influenzae was not found in this study. The mortality rate was 40%.

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Introduction

Acute bacterial meningitis is a potentially fatal acute infectious disease caused by a variety of bacteria and is still considered as one of the major problems in pediatric infections in Indonesia (Bambang et al., 1967; Muljono et al., 1966; Tri Ruspandji et al., 1981).

Although the number of reported fatalities from many infectious diseases decreased by 10 to 20 fold since 1935, the reported number of deaths from bacterial meningitis decreased only by one half (Vaughn et al., 1979).

Despite the availability of chemotherapeutic agents that, in vitro, are capable of killing the microorganism causing most of these infections, children with acute bacterial meningitis are encountered frequently.

The etiologic organism, early diagnosis, prompt and proper treatment and the general condition of the patients are factors on which the outcome of the disease in a certain case depends (Muljono et al., 1966; Vaughn et al., 1979).

The purpose of this study is to present the causative agents, the results of treatment and the complications in infants and children with acute bacterial meningitis in Surabaya.

Materials and Methods

This study was conducted from October 1979 until June 1981 at the Department of Child Health, Dr. Soetomo Hospital, Surabaya. During this period of time all patients with acute bacterial meningitis who had not been (partially) treated were included in the study. The diagnosis of acute bacterial meningitis was based on the clinical findings and the results of the cerebrospinal fluid examination.

Cerebrospinal fluid was obtained by lumbar puncture with a sterile disposable needle. About twenty drops of fluid were directly inoculated on two kinds of media, blood agar plate and chocolate agar plate. The inoculated media were kept at room temperature before they were sent to the laboratory. After 48 hours cultures were examined for growth of bacteria. Sensitivity tests were made from positive cultures.

Cerebrospinal fluid examination were done on the first, third and seventh day of hospitalization to determine total cell count, protein and glucose concentrations. Additional CSF examinations were performed when necessary. Blood, urine and feces analyses were performed as routine examinations.

Treatment was started immediately on admission without waiting for the results of the culture. All patients got an intravenous fluid drip directly as they usually came in an unconscious state. They were given chloramphenicol 100 mg/kg body weight/day divided in 4 doses and ampicillin 400 mg/kg body weight/day divided in 4 doses. These drugs were given intravenously until the patient was afebrile for at least 3 days, to be followed by oral administration of half the above doses as the condition of the patient improved. The total duration of the the treatment was at least 10 days in every patient. An anti-convulsive drug (diazepam, 0,2 mg/kg body weight/dose) was given intravenously on the first and second day of admission if necessary. Blood and plasma transfusions were given when necessary.

Results

During this period of time 40 cases of acute bacterial meningitis have been studied.

The number of cases by age ar are shown in Table 1.

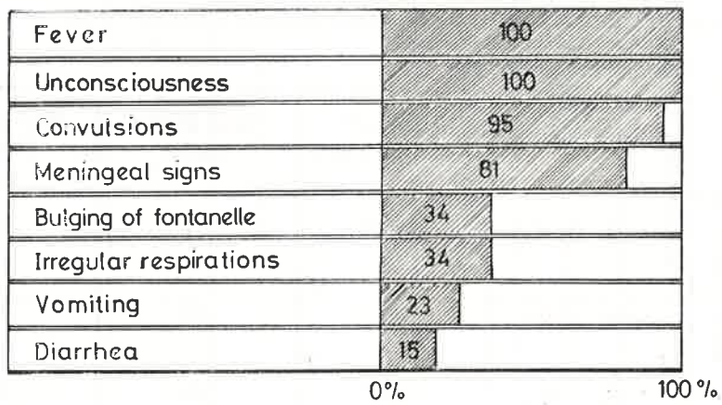
TABLE 1: *Number of cases by age and sex*

A g e	Male	Female	Total
0 — 2 mo	4	3	7
2 — 24 mo	12	15	27
> 24 mo	4	2	6
	20	20	40

The youngest case was a baby of 27 days, while the oldest one was a 9 year old boy.

The clinical signs and symptoms of the patients on admission are summarized in Table 2. All patients had fever.

TABLE 2: *Clinical signs and symptoms in 40 patients*



The mean duration of fever before admission was 4 days, with a range of 1 - 14 days. Twenty four patients (60%) had fever for 1 - 3 days before admission, 14 patients (35%) for 4 - 10 days and 2 patients (5%) for 14 days. All patients had lowered consciousness of varying degrees, restlessness in 9 (22,5%), apathy in 11 (27,5%), somnolence in 9 (22,5%) and sopor in 11 patients (27,5%).

Most of the patients (95%) had convulsions on admission. Only two children showed no convulsions, but 4 and 6 hours after admission they had seizures.

The laboratory findings during this study are summarized in Table 3.

Thrombocytopenia (platelets < 100.000/mm³) was encountered in 3 patients (8%) on the first day, in 5 (17%) on the third day and in another 5 patients (21%) on the seventh day. On the seventh day two children had very low platelet counts (1.000 and 3.000/mm³).

The mean hemoglobin concentration was rather low (10,4 g/dl.) on the first day, it decreased slightly on the third (9,8 g/dl) and seventh day (9,1 g/dl).

TABLE 3 : *Laboratory findings*

	Day of hospitalization		
	1st (n = 36)	3rd (n = 30)	7th (n = 24)
Hb (g/dl) : mean	10,4	9,8	9,1
range	7,2 — 13,3	6,7 — 12,5	6,1 — 15,0
WBC (/mm³) : mean	13.000	12.000	10.900
range	5.600 — 25.100	7.200 — 23.100	4.400 — 17.900

TABLE 4 : *Cerebrospinal fluid data*

	Appearance	Mean cell count per mm³	Mean glucose (mg%)	Mean protein (mg%)
1st day (n = 36)	cloudy (72%)	1920/3	22	144
3rd day (n = 30)	cloudy (48%)	1730/3	22	106
7th day (n = 24)	cloudy (6%)	320/3	26	60

The urine and stools were normal in all of the patients.

The results of examination of the cerebrospinal fluid are summarized in Table 4.

Cloudy or opalescent CSF was observed in 72% of the cases on the first day of admission, in 3 patients the CSF was purulent. On the third day cloudy CSF was found in 48% and by the seventh day almost all CSF had become clear (94%).

The mean cell count was very high on the first day of admission (1920/3), in 9 patients the cells were innumerable. On the third day the mean cell count was slightly decreased (1730/3), innumerable in 4 patients. By the seventh day the mean cell count had become nearly normal (320/3). In the cases with high cell counts the cells were predominantly polymorphonuclears (70 to 90%).

The CSF glucose concentration was low in all patients on the first, third and seventh day. Mean CSF glucose concentrations were 22 mg/dl., 22 mg/dl. and 26 mg/dl. respectively.

The mean CSF protein concentration was increased on the first day (144 mg%), it decreased to 106 mg% on the third, and 60 mg% on the seventh day.

There were 20 positive CSF cultures from a total of 34 inoculations. The distribution of the positive cultures by age group and micro-organism are shown in Table 5.

TABLE 5 : *Positive bacterial cultures by age group and microorganism*

	Number of patients whose culture of CSF showed the growth of :						
Age	Diplococcus pneumoniae	Staphylococcus aureus	E. Coli	Enterobacter aerogenes	Salmonella paratyphi B	Streptococcus pyogenes	Pseudomonas aerugenosa
0 — 2 mo	1	—	1	1	1	—	1
2 — 24 mo	4	5	1	1	1	1	—
> 24 mo	2	—	—	—	—	—	—

The most frequent causative agent of acute bacterial meningitis in this study was Diplococcus pneumoniae (35%), while the second was Streptococcus aureus (25%). Other causative agents were: E. Coli (10%), Enterobacter aerogenes (10%), Salmonella paratyphi B (10%) and Pseudomonas aerugenosa (5%). Hemophilus influenzae was not found in this study.

Of the 40 infants and children with acute bacterial meningitis in this study 16 died, an overall mortality of 40%. Of the 16 patients who died, seven patients (44%) expired during the first day of hospitalization. The mortality by age and sex are shown on Table 6.

TABLE 6: *Mortality by age and sex*

Age	Mortality	
	Male	Female
0 — 2 mo	2/4	1/3
2 — 24 mo	5/12	5/15
> 24 mo	2/4	1/2
Total	9/20	7/20

The complications found in this study are listed in Table 7.

Nine complications occurred in children less than 2 years of age (26%), as against one in 6 patients over 2 years (16%). Two patients with aspiration pneumoniae died while their meningitis was improving.

Discussion

The incidence of acute bacterial meningitis is not reflected in this study since only fresh cases were included. Tri Ruspandji et al. (1981) found in Jakarta in 1976 an incidence of 1,9% of the total pediatric admissions. Their figure was similar to that reported in Iran and U.S.A. (cited from Tri Ruspandji et al., 1981).

The clinical signs and symptoms as well as the laboratory findings observed in this series confirmed with those described in textbooks (Kempe et al., 1980; Krugman and Ward, 1973) (see Table 2 and Table 3). The values for WBC, hemoglobin concentration and platelet count reversed to (almost) normal in the course of the disease when the child survived. Apparently the initial abnormal data were due to the disease process.

TABLE 7: *Complications*

Age	Number of patients with			
	Hydrocephalus	Hemiparesis	Subdural effusion	Aspiration pneumonia
0 — 2 mo	1	—	1	1
2 — 24 mo	2	2	1	1
> 24 mo	—	1	—	—

The diagnosis of acute bacterial meningitis is based on the clinical findings and examination of the CSF which shows: (1) a cloudy appearance, (2) an increased white blood cell count with a predominance of polymorphonuclear leucocytes, (3) a low glucose concentration, (4) an elevated protein level and (5) a smear or culture positive for the causative micro-organism (Kempe et al., 1980; Krugman and Ward, 1973; Vaughn et al., 1979). The cell count may be extremely variable, usually well over 1000 per cubic millimeter in most cases. In rare instances, particularly very early in the disease, the cell count may be normal in the face of a positive culture of a CSF specimen. Glucose concentration is usually low in acute bacterial meningitis. CSF glucose should be compared with blood glucose concentration obtained concomitantly. Protein concentration is usually increased, though it is not a helpful diagnostic aid early in the course of the disease.

In our study cloudy appearance of CSF was observed in 72% of the cases on admission. The mean cell count was 1920/3, with a range of 72/3 to 6500/3, with 70 - 90% PMN in the cases with high cell counts.

The mean CSF glucose was decreased to 22 mg%. No concomitant blood glucose concentrations were measured. The mean CSF protein was increased (144 mg%), it returned to almost normal levels on the seventh day (60 mg%).

It was of particular interest that the CSF cultures of our patients (Table 5)

revealed Diplococcus pneumoniae as the most frequent causative agent (35%) with Staphylococcus aureus ranking second (25%).

Other causative micro-organisms were: E. coli (10%), Enterobacter aerogenes (10%), Salmonella para typhi B (10%), domonas aerugenosa (5%). Hemophilus influenzae was not found in this study.

In this aspect it differed from other reports (Ahronheim, 1979; Kempe et al., 1980; Sujudi and Madjid, 1965), where the most frequent offending micro-organisms were found to be Hemophilus influenzae, Diplococcus pneumoniae and Neisseria meningitides. Smith (1954) in his review of 409 cases from 1944 to 1953 found that the most common cause of acute bacterial meningitis in infants and children were Hemophilus influenzae, Neisseria meningitides and Diplococcus pneumonia. Haggerty et al., in 1960 also found that the most causative micro-organism were Hemophilus influenzae, Neisseria that the most causative agents in his study were : Neisseria meningitides (45%), Hemophilus influenzae (30%) and Diplococcus pneumonia (11%).

Sujudi and Alwi Madjid (1965) in their study in Jakarta in 1962 found that the most common etiologic organisms were Diplococcus pneumoniae, Hemophilus influenzae and Streptococci, while in 1967, Bambang Madijono et al. found Hemophilus influenzae and Diplococcus pneumoniae as the most common causative agents. However, in 1977 Tri Ruspandji et al. indicated that there seemed to be a change in the leading etiological cause (s) of acute bacterial meningitis in infants and children from Hemophilus influenzae to Salmonella sp. It appeared that in our study this change, if any, was to Diplococcus pneumoniae.

Of the 40 infants and children in this study 16 died, an overall mortality of 40% (Table 6). Similar mortality rates, have been reported in Indonesia. Muljono Maksum et al. in 1967 found an overall mortality of 47,2% and Tri Ruspandji et al. in 1977 41,8%. These mortality rates were very high as compared to those from abroad. Smith (1954) reported a mortality rate of 31%, fifty percent of the deaths of his cases were in the first year of life. Goldacre in 1976 reported a case fatality rate of 12,7%.

Several factors might be responsible for the changes in bacterial etiology as well as the high mortality rate, e.g. delay to bring the patients to the hospital for treatment and the development of resistance of certain causative agent to the widely used antimicrobial agents. This speculation needs further investigation.

The complication in our study (Table 7) affected mostly patients less than 2 years of age, confirming reports by others, such as Tri Ruspandji et al. (1977) who reported an incidence of 90% in patients less than one year of age. Subdural effusion was not frequently found in our study (5%) compared to other reports with up to 74% in one series (10%).

Three of our patients had hemiparesis, one of them showed improvement of the sequellae during a one year follow-up.

The prognosis of acute bacterial meningitis depends on a variety of factors including : (1) the patient's age, (2) the type of micro-organism, (3) the severity of infections, (4) the duration of illness before onset of therapy and (5) the sensitivity of the organism to the antimicrobial drugs (Krugman and Ward, 1973; Vaughn et al., 1979). The relatively high mortality in our series could probably be reduced if the patients came in an intensive care unit.

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