Acute Bacterial Meningitis

in Childhood

BY

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A review of cases of acute bacterial meningitis occurring in children up to and including the age of twelve years admitted to Harari Hospital during the years 1967 - 1969 inclusive, was carried out. After excluding those cases in which meningitis was secondary to suppuration in the accessory nasal sinuses, brain abscess, meningomyelocoele, compound fractures of the skull and one case of terminal infection in a child with chronic renal failure, there remained 200 cases for analysis. As will be seen from Table I, there were 13 meningococcal infections, nine streptococcal, two staphylococcal and one case from which N. catarrhalis was isolated. The remaining cases, 175, comprised 67 pneumococcal, 44 H. influenzal and 64 in which no definite bacterial pathogen was isolated (pyogenic no organisms). The yearly admission rate of these three groups taken together was fairly constant, 57 were admitted in 1967, 56 in 1968, and 62 in 1969, but comparing the figures for 1967 and 1969, it will be seen that while admissions for pneumococcal meningitis fell by just over one half, admissions of cases of H. Influenzal meningitis more than doubled. The figures for cases of pyogenic meningitis showed a small yearly increase.

Table I shows the striking differences in age incidence as between the various groups of cases. Meningococcal meningitis was seen throughout the whole period of childhood while streptococcal meningitis occurred only in the first two months of life. Both pneumococcal meningitis and pyogenic meningitis while having their greatest incidence in the early months of life were not infrequent after this period, while meningitis due to *H. influenzae* was not seen before the age of three months, its peak incidence was at the age of six months and only three cases occurred after the age of 12 months. Again taking the three main groups as a whole, there was a marked

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TABLE 1

		1/12	1/12	2/12	3/12	4/12	5/12	6/12	7/12	8/12	9/12	10/12	11/12	1 Yr	2	3	4	5	6	7	8	9	10	11	12	TOTAL
PNEUMOCOCCAL	ADMISSIONS	2	8	5	8	3	3	2	6	3	2	1	2	11	3	-	2	1	-	3	-	*	-	1	1	67
	DEATHS	1	6	5	1	2	2	1	1	-	2	1	2	4	2	-	1	-	-	-	-	-	-	-	-	31
H. INFLUENZAE	ADMISSIONS	-	-	-	2	2	5	11	10	2	3	6	-	2	1	-	-	-	-	-	-	-	-	-	-	44
	DEATHS	-	-	-	2	1	1	1	1	1	1	1	4	-	1	-	-	-	-	-	-	-	-	-	-	13
PYOGENIC	ADMISSIONS	8	8	3	-	3	3	5	4	3	1	3	-	4	4	2	-	1	1	3	3	3	1	1	-	64
	DEATHS	4	4	1	-	2	1	2	4	3	1	1	-	1	2	-	-	1	-	1	-	2	-	1	-	31
MENINGOCOCCAL	ADMISSIONS	-	-	-	1	1	-	1	-	-	1	-	-	1	1	1	1	-	-	1	-	-	-	2	2	13
	DEATHS	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
STREPTOCOCCAL	ADMISSIONS	7	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
	DEATHS	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2

OTHER ORGANISMS - 3 - (N. CATARRHALIS - 1 -)

(STAPHYLOCOCCI - 2 -)

(- 1 - Death)

Table 1—Relates the types of meningitis to age and mortality.

TABLE 2

		1967	1968	1969
PNEUMOCOCCAL	ADMISSIONS	29	24	14
	DEATHS	13	9	9
H. INFLUENZAE	ADMISSIONS	10	10	24
	DEATHS	3	-	10
PYOGENIC	ADMISSIONS	18	22	24
	DEATHS	8	13	10
MENINGOCOCCAL	ADMISSIONS	2	6	5
	DEATHS	-	—	1

Table 2—Relates the types of meningitis to the year of admission and mortality.
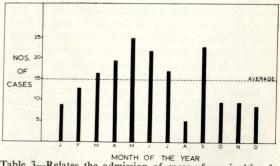
variation in the numbers of admissions as related to the month of the year (Table III). The average monthly admission rate was exceeded during the period March to July inclusive and there was a single isolated peak during the month of September. Of the total of 200 cases 79 died. The death rate was lowest in the meningococcal group, marginally higher in the pyogenic than in the pneumococcal cases, and significantly lower in the *H. influenzal* group than in both the pneumococcal and pyogenic groups. The relationship of age to the outcome was shown in that during the first three months of life of 15 cases of pneumococcal meningitis, 13 died and in the pyogenic group 16 of 19 died. An attempt was made to assess the quality of survival. As recorded in the case notes, residual cerebral damage was noted in 14 survivors of pneumococcal meningitis, in 15 of the *H. influenzae* survivors and two cases in the pyogenic group.
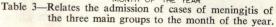
Discussion

The present series may be compared with previous series, Mathies & Wehrle (1968) and Glyn Jones (1968). Meningococcal meningitis occurs at any age at times sporadically but at other times in epidemic outbreaks of explosive violence. In our series it behaved sporadically. Streptococcal meningitis is predominantly a disease of early infancy and in this series was confined to the first two months of life. The greatest contrast with previous series is in relation to pneumococcal meningitis, *H. influenzal* meningitis and the pyogenic group. Pneumococcal meningitis is substantially more frequent in the present series than in series reported from elsewhere, but during the period under review the absolute yearly figure fell

TABLE 3

Table 3—Relates the admission of cases of meningitis of the three main groups to the month of the year.

TABLE 4

	PRESENT SERIES	MATHIE AND WEHRLE
PNEUMOCOCCAL	38%	13%
H. INFLUENZAE	25%	67%
PYOGENIC (NO ORGANISM)	37%	20%

Table 4—Compares the present series with the series of Mathies and Wehrle.

from 29 in 1967 to 14 in 1969, or expressed as a percentage of the three main groups from 51 per cent. to 23 per cent. During the same period the yearly admissions for *H. influenzal* meningitis increased from 10 to 24, or expressed as a percentage, from 18 per cent. to 30 per cent. This trend is towards the frequency distribution seen in the developed countries as recorded by Mathies *et al*. (Table IV). In respect of pyogenic meningitis the incidence in our series is almost double the figures quoted by Mathies—37 per cent. as against 20 per cent. The incidence of pneumococcal meningitis is likely to be a reflection of the prevalence of pneumococcal infections in the general community and it would be interesting to compare the pneumococcal types recovered from cases of meningitis with those recovered from cases of acute lobar pneumonia. Even so the fall in admissions for primary lobar pneumonia at all ages at Harari Hospital during this period from 443 cases in 1967 to 325 cases in 1969 indicating a reduced incidence of pneumococcal infections in the general population, seems too small to be solely responsible for the declining incidence of pneumococcal meningitis. There is also to be taken into consideration the increase in cases of *H. influenzal* meningitis and the high incidence of pyogenic meningitis. All these changes might be explained if during this period penicillin were being used on an increasing scale and local enquiries seem to indicate that this is the case. The pneumococcus is more susceptible to the action of penicillin than is *H. influenzae*. The increasing use of penicillin would therefore be expected to cause a fall in pneumococcal infections in the population generally. It is also likely that at least in some cases penicillin when given to a child with a primary respiratory infection would prevent the development of a pneumococcal meningitis but not meningitis due to the less susceptible *H. influenzae*. Thus a falling incidence of pneumococcal meningitis and an increasing incidence of H. influenzal meningitis would be explained.

There was a quite sharp difference between the age incidence of meningitis due to *H. influenzae* and the other two main groups, pneumococcal and pyogenic. No case of H. influenzal meningitis

occurred under the age of three months, its maximum incidence was at six months and only three cases of 44 occurred after the age of 12 months. Such an age distribution suggests very strongly that an immunoglobulin of the IgG class is responsible for resistance to this organism and that as a consequence of maternal transplacental donation, the newly born child is well protected until the level of passively acquired antibody has fallen. Once an active immunity has been acquired resistance is high and prolonged. In contrast the infant in the first few months of life shows a marked susceptibility to pneumococcal meningitis and although susceptibility to this infection diminishes after the age of one year, cases of meningitis due to this organism are seen throughout the whole period of childhood. The early susceptibility to infection is correlated with the fact that immunoglobulins active against the pneumococcus are contained within the IgM group which is not transferred from the maternal to the foetal circulation: Burrell (1969). The persisting susceptibility to infection is capable of two explanations. Actively produced antibody to the pneumococcus is not very long lasting and also since the pneumococcus is of many antigenically separate types, exposure to one type does not prevent infection with an organism of a different type in contrast to the situation with H. influenzal meningitis in which infections are due to one type only, namely type B.

The rate of monthly admissions for meningitis in the three main groups showed an interesting pattern. From March to July admissions were above the monthly average, they fell to a low level in August and this was followed by an isolated peak in September. The preponderance of cases in the period March to July can probably be explained by climatic conditions, but the peak in September occurs at a time when the weather is not favourable for the promotion and dissemination of respiratory infections. One possible explanation is that September is a month during which there is a lull in seasonal agricultural work and that it is the time of year when visits to friends and relatives are customary. This would allow upper respiratory infections to become disseminated more widely beyond the immediate family circle.

Taking the three main groups together, there was an overall mortality of 43 per cent. (75 deaths in 175 cases). The death rate was lowest in H. influenzal infections, 30 per cent., in the pyogenic group death occurred in 48 per cent. of admissions and in the case of pneumococcal infections in 46 per cent. The age distribution of the cases of H. influenzal meningitis does not allow an analysis of the relationship of age to

outcome. However, in both pneumococcal meningitis and the pyogenic group the mortality was over 50 per cent. in children under the age of one year, and around 30 per cent. in those aged one year and older. The effect which age had upon the outcome was most marked in pneumococcal meningitis, of 15 children under the age of three months, 12 died.

The death rates in acute bacterial meningitis do not in themselves give a complete picture of the effects of the disease since many of the survivors were known to have residual cerebral damage and this was noted to be present in 14 of the survivors of pneumococcal meningitis, 15 of the H. influenzal group and five in the pyogenic group. These figures are undoubtedly less than would have been found had it been possible to carry out a reassessment at a later date, but out of a total of 175 admissions no less than 109 either died or were left with a significant degree of brain damage. Thus the cure rate for these three groups taken as a whole is not in excess of 38 per cent. and is probably much lower. In the light of these figures what can be done to improve on the results of treatment? There is no doubt that early and effective treatment is the first essential. The suspicion of the possibility of meningitis in any child will indicate the necessity for a lumbar puncture. In situations where this cannot be carried out or the cerebrospinal fluid adequately examined and cultured, the child should be immediately transferred. It is further recommended that before being transferred an intramuscular injection of 1,000,000 units of penicillin should be given. Such a dose of penicillin may make the organism more difficult to isolate but it will also save lives and reduce the chances of disability in the survivors. The standard treatment for bacterial meningitis of all types is triple therapy, chloramphenicol 100/mgm per kilo per day, penicillin 500,000 units 6 hourly and sulphadimidine 200 mgms per kilo per day. Although recently ampicillin has been advocated in the treatment of H. influenzal meningitis no significant difference in mortality and morbidity has been shown when this drug is used in preference to chloramphenicol (Gellis & Kagan, 1970). It is recommended that where possible these agents should be given intravenously at least for the first 12 hours and that in the case of pneumococcal infections the dose of penicillin should be increased to 1,000,000 units 2 hourly.

Since natural resistance to both pneumococci and H. influenzae is largely mediated by humoral mechanisms would treatment be improved if specific antibodies could be provided? Prior to the advent of sulphonamides treatment of lobar pneumonia with specific antiserum where facilities for typing the pneumococcus were available was highly effective: Mudd, S. (1970). Prepared type specific sera are no longer available, but a trial is being conducted at present in which in addition to antibiotic therapy fresh frozen plasma is being given intravenously in a dose of 10 ml. per kilo. If one is fortunate the infused plasma will contain antibodies and in any event such treatment is not likely to do harm since the chances of transmitting homologous serum jaundice using a single donor is minimal.

Treatment of acute bacterial meningitis in childhood includes many other measures prominent amongst which are the prevention and prompt treatment of convulsions and attention to fluid balance.

SUMMARY

Cases of acute bacterial meningitis in childhood admitted to Harari Hospital from 1967 to 1969 are reviewed. Attention is drawn to the changing pattern of the disease, the seasonal variations, the age incidence and the prognosis. Recommendations are made as to treatment.

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