

Antibiotic Sensitivity and Resistance Patterns of Bacterial Isolates from Ghanaian Children with Pyogenic Meningitis

OP Rodrigues⁺ and JOO Commey⁺⁺

Summary

Rodrigues OP and Commey JOO. Antibiotic Sensitivity and Resistance Patterns of Bacterial Isolates from Ghanaian Children with Pyogenic Meningitis. *Nigerian Journal of Paediatrics* 1995; 22: 36. Cerebrospinal fluid (CSF) obtained from 103 patients with bacterial meningitis, aged between two months and 12 years, was examined microbiologically, including culture for bacterial organisms and their sensitivity/resistance patterns. Isolated bacteria comprised *Strep pneumoniae* 48.0 percent, *N meningitidis* 38.4 percent, *H influenzae* 9.6 percent, *Staph aureus* 2.7 percent and alpha - *H strep* 1.4 percent. *Strep pneumoniae* and *H meningitidis* occurred in all the age groups, while *H influenzae* and *Staph aureus* occurred in the age group, three to 30 months. All the isolates, except one case of *Staph aureus*, were sensitive to ceftriaxone, while *Strep pneumoniae* isolates were sensitive to penicillin in 91 percent, to ampicillin in 94 percent, to chloramphenicol in 83 percent and to cefuroxime in 94 percent of the cases; this organism was resistant to co-trimoxazole in 66.0 percent of the cases. Between 79 and 100 percent of the cases of *N meningitidis* were sensitive to penicillin, ampicillin, chloramphenicol and cefuroxime; this organism was resistant to co-trimoxazole in 75 percent of the cases. In view of the high level of sensitivity of most of the isolates in the present study, to cefuroxime and ceftriaxone, it is suggested that these third generation cephalosporins, be included in the recommended initial antibiotic therapy at the primary health care centres.

University of Ghana Medical School, Accra

Department of Child Health

+ Lecturer

++ Associate Professor

Correspondence: OP Rodrigues

P.O. Box 4236 Accra, Ghana.

Introduction

Most children with bacterial meningitis in developing countries are usually seen initially by general duty physicians, or by low level health workers at the community health centres and these workers often treat such patients with a variety of medications.

Indeed, the World Health Organization (WHO) has recommended the administration of antibiotics by low level health workers to children with acute respiratory infections (ARI)¹ and such recommended antibiotics include benzylpenicillin, ampicillin, co-trimoxazole and chloramphenicol. Most of these are also the main drugs that are currently used in the treatment of several infections, including bacterial meningitis. It has however, been suggested that such recommended policy of antibiotic therapy may lead to low yield of causative organisms in culture of cerebrospinal fluid (CSF) from patients with meningitis who might have received an antibiotic for ARI prior to attending the hospital.^{2,3} In our recent study of bacterial meningitis,⁴ it was shown that 24.3 percent of patients with the disease, were referred from the primary health-care level within 48 hours, after they might have received any of the above antibiotics; indeed, as many as 20.4 percent of the patients were referred after a week of onset of the illness.

The increasing number of causative bacterial organisms that are resistant to penicillin,⁵ ampicillin and chloramphenicol⁶ as well as the recognized problems associated with the use of chloramphenicol singly, or in combination with other antibiotics used in the treatment of meningitis,⁷ have suggested that medical institutions in developing countries should establish the relationship between local bacterial organisms and their sensitivity pattern to readily available antibiotics. The present study was therefore, aimed at investigating the pattern of antibiotic sensitivity and resistance to organisms cultured from the CSF of patients with meningitis who had been

treated by general practitioners prior to referral.

Patients and Methods.

All the patients with clinically suspected meningitis referred to the emergency and ambulatory services in the department of Child Health, Korle Bu Teaching Hospital, University of Ghana Medical School, Accra, were included in the study. CSF was obtained for laboratory studies, including macroscopic appearance of the fluid, cell count, Gram-stain, culture and sensitivity of isolated organisms. The *in-vitro* sensitivity/resistance of the bacterial isolates was tested against benzylpenicillin, ampicillin, co-trimoxazole, chloramphenicol, cefuroxime and ceftriazone, using the paper disc method.⁸

Results

There were 103 patients, aged between two months and 12 years, who had bacterial meningitis. The CSF was described as frankly turbid or hazy in appearance in most

TABLE I

Age groups and 73 Bacterial Isolates from 103 Patients with Pyogenic Meningitis					Isolate	Total No of Isolates
Age (months)	3-12	13-30	31-60	61-146		
9	4	3	19		<i>Strep pneumoniae</i>	35(47.9)
9	3	4	12		<i>N meningitides</i>	28(38.4)
2	5	0	0		<i>H influenzae</i>	7(9.6)
1	1	0	0		<i>Staph aureus</i>	2(2.7)
0	0	0	1		<i>Haem strep</i>	1(1.4)
Total						73(100.0)

Figures in parenthesis represent percent of total.

TABLE II
Antibiotic Sensitivity and Resistance Patterns of 73 Bacterial Isolates

Isolate	Antibiotic Sensitivity and Resistance Pattern											
	P		Am		Co-t		Ch		Ce		Cef	
	S	R	S	R	S	R	S	R	S	R	S	R
<i>Strep pneumoniae</i>	32	3	33	2	12	23	29	6	33	2	35	0
	(91)	(9)	(94)	(6)	(34)	(66)	(83)	(17)	(94)	(6)	(100)	(0)
<i>N meningitidis</i>	23	5	22	6	7	21	26	2	28	0	28	0
	(82)	(18)	(79)	(21)	(25)	(75)	(93)	(7)	(100)	(0)	(100)	(0)
<i>H influenzae</i>	-	-	4	3	1	6	7	0	3	4	7	0
			(57)	(43)	(14)	(86)	(100)	(0)	(43)	(57)	(100)	(0)
<i>Staph aureus</i>	0	2	0	2	2	0	1	1	2	0	1	1
	(0)	(100)	(0)	(100)	(100)	(0)	(50)	(50)	(100)	(0)	(50)	(50)
<i>H strep</i>	1	0	1	0	0	1	1	0	1	0	1	0
	(100)	(0)	(100)	(0)	(0)	(100)	(100)	(0)	(100)	(0)	(100)	(0)

P = penicillin, Am = ampicillin, Co-t = co-trimoxazole, S = sensitivity, R = resistance, Ch = chloramphenicol, Ce = cefuroxime, Cef = ceftriaxone
Figures in parenthesis represent percent of total.

of the specimens. In 93 (90.3 percent) of the 103 CSF samples, polymorphonuclear leucocyte cell count was greater than 100×10^6 /L. Gram - stain was positive in 74 (71.8 percent) and negative in 29 (28.2 percent) of the 103 samples. Of the 74 positive Gram-stain, 72 (97.3 percent) yielded bacterial organisms on culture. There was one (3.4 percent) bacterial isolate out of the 29 negative Gram-stain. There were thus, 73 (70.9) bacterial isolates from the 103 CSF samples. The isolates (Table 1) comprised 35 (47.9 percent) of *Streptococcus pneumoniae* (*Strep pneumoniae*), seven (9.6 percent) of

Haemophilus influenzae (*H influenzae*), two (2.7 percent) of *Staphylococcus aureus* (*Staph aureus*) and one (1.4 percent) of alpha - *Haemolytic Streptococcus* (*Haem strep*). These isolates were cultured from 42 (57.5 percent) males and 31 (42.5 percent) females, a sex ratio of 1.35:1 (P>0.05). While *Strep pneumoniae* and *N meningitidis* occurred in all the age groups, *H influenzae* and *Staph aureus* occurred in the age groups three to 30 months.

The antibiotic sensitivity and resistance patterns of the isolates are shown in Table

II. All the isolates, except *Staph aureus*, were sensitive to ceftriaxone. Of the 35 *Strep pneumoniae* isolates, 32 (91 percent) were sensitive to penicillin, 33 (94 percent) to ampicillin, 29 (83 percent) to chloramphenicol and 33 (94.3 percent) to cefuroxime. Resistance of *Strep pneumoniae* to cotrimoxazole occurred in 23 (66 percent) of the cases. Sensitivity of the 28 *N meningitidis* isolates to penicillin, ampicillin, chloramphenicol and cefuroxime was 82 percent, 79 percent, 93 percent and 100 percent, respectively. Resistance of this isolate to cotrimoxazole was 75 percent. *H influenzae* isolate was 100 percent sensitive to only chloramphenicol and 86 percent sensitive to co-trimoxazole.

Discussion

In the present study, *Strep pneumoniae*, comprising 48 percent of the isolates, was the leading organism in the series; it was followed by *N meningitidis* with 38.4 percent and *H influenzae* with 9.6 percent. This finding is similar to those reported by other African workers.⁹ It is noteworthy that, while *Strep pneumoniae* and *N meningitidis* occurred mostly in older patients, aged between 31 and 144 months, *H influenzae* and *Staph aureus* occurred in younger patients, aged 30 months and below. Pyogenic meningitis has continued to be associated with a high childhood mortality in most developing countries.^{3 4 9 10} For instance, our recent study of the disease in Ghana, has revealed a mortality of 22.4 percent,⁴ a rate which is much higher than those in developed countries.¹¹ This high mortality rate from developing countries is due mostly to late referral of patients from

the primary health-care level to secondary or tertiary-care institutions, unavailability of appropriate antibiotics and inadequate or inappropriate antibiotic therapy. The choice of antibiotics for the treatment of severe bacterial infections generally and of meningitis, in particular, has now become problematic because of the increasing emergence of antibiotic resistance. The sensitivity and resistance patterns of the organisms to the commonly used antibiotics (ampicillin, penicillin and chloramphenicol) as shown in the present study, has given cause for great concern, especially as these drugs, together with co-trimoxazole, constitute the recommended antibiotics for use in primary health-care institutions for children with infections, prior to referral to hospital.¹

There are some strains of *H influenzae* that are resistant to ampicillin and chloramphenicol, respectively and because of this, alternative antibiotics have been recommended as a first-line therapy.¹² It should however, be noted that in the present study, resistance of *H influenzae* to chloramphenicol and ampicillin was zero and 43 percent, respectively. Although *H influenzae* was only 9.6 percent of all the infections, it occurred only in patients under five years of age, an age group in which, throughout the developing countries, childhood mortality is reported to be 104/1000 live births as compared to 11/1000 live births in developed countries.¹³ Though not recommended as the first lines of therapy, chloramphenicol and ampicillin may be used in the treatment of pyogenic meningitis.

Strep pneumoniae which accounted for

47.9 percent of the 73 isolates, was resistant to ampicillin in six percent, to ampicillin in nine percent and to chloramphenicol in 17 percent of the cases. Similarly, *N meningitidis* was resistant to penicillin in 18 percent. The high resistant levels of these two isolates to the above antibiotics have been reported by other West African workers.^{14 15} With 56 percent of *Strep pneumoniae*, 75 percent of *N meningitidis* and 86 percent of *H influenzae* resistant to cotrimoxazole, it is recommended that this antibiotic should not be included in the list of drugs for treatment of these causative and leading organisms in pyogenic meningitis.

Future antibiotic therapy for childhood infections may well rely on yet to-be developed agents as suggested by Smith,¹⁶ but presently, third generation cephalosporins are important additions to the range of available antibiotics for treating serious bacterial infections. In the present study, 98.6 percent of all the isolates were sensitive to ceftriaxone, while *Staph aureus* was sensitive to cefuroxime and partially to ceftriaxone. Several gram-negative organisms which cause infections in early childhood, including *Klebsiella pneumoniae*, *E coli* and *Citrobacter diversus* are also susceptible to these antibiotics.¹⁷ While the cost is an important consideration in the choice of first-line antibiotics for the primary health-care institutions in developing countries, the efficacy and effectiveness of the antibiotics against common local organisms should also be seriously considered. In view of the

sensitivity of *Staph aureus* to cefuroxime and ceftriaxone as shown in the present study and their effectiveness against gram-negative organisms as shown by Kaplan,¹⁷ it is suggested that the recommended initial antibiotic treatment at the primary health-care level by WHO,¹ be broadened to include these third generation cephalosporins.

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