Journal of Scientific and Innovative Research 2013; 2 (6): 1012-1016
Available online at: www.jsirjournal.com

Research Article

ISSN 2320-4818
JSIR 2013; 2(6): 1012-1016

Received: 01-08-2013
Accepted: 19-12-2013

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Pattern and antibiogram of bacterial meningitis in children at a tertiary care hospital

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Abstract

Acute bacterial meningitis (ABM) among the 10 major causes of mortality from infectious disease over the world, mainly in the pediatric population. Despite the availability of potent newer antibiotics, the mortality rate due to ABM remains significantly high in India. Information from laboratory based surveillance is important in determining the most common etiology of meningitis pathogens. It is further necessary for improving the clinical management of cases, guiding therapeutic decisions and for designing preventive strategies. The study was done with an objective to know the different organisms responsible for meningitis and their antibiotic susceptibility patterns. This was a retrospective study conducted at a tertiary care hospital in South India. The data was obtained from Microbiology laboratory using the records from March 2011 to March 2013. The isolates were identified by standard techniques and antibiotic susceptibility tests were done in accordance with Clinical Laboratories Standards Institute (CLSI) guidelines. Out of 1095 CSF samples were studied, 209 were positive for culture. The most common organisms were Gram positive (63.1%). Among the Gram positive organism, most common organism was *S. pneumoniae* and among Gram negative organisms, K. pneumoniae was the most common organism. Gram positive organisms were resistant to commonly used antibiotics such as Ampicillin, Ciprofloxacin and Erythromycin. No resistance was seen to Linezolid and Vancomycin. Among the Gram negative organisms, high resistance was seen with Chloramphenicol and Ceftriaxone and least with Piperacillin+tazobactum and Imipenem. Regular prevalence and antibiotic susceptibility studies will help to detect the change in causative organism of ABM and also help pediatricians in choosing an appropriate antimicrobial agent.

Keywords: Bacterial meningitis, Antibiogram, Children, *Streptococcus pneumoniae*.

Introduction

Meningitis is an inflammation of the meninges, the membranes surrounding the brain and spinal cord.[1] Acute bacterial meningitis (ABM) among the 10 major causes of mortality from infectious disease over the world, mainly in the pediatric population.[2] Despite the availability of potent newer antibiotics, the mortality rate due to ABM remains significantly high in India and other developing countries, ranging from 16-32%.[3] Although the rate of disease associated with meningitis is lower than other major causes of childhood morality, the high case fatality rates and neurologic sequelae in survivors result in considerable emotional and financial burden on the family and presents a major challenge to the health care system in financial and human resources.[4]

ABM is principally a disease of early childhood with more than 50 per cent of cases occurring in children less than five years of age. There is a need for a periodic review

of bacterial meningitis worldwide, since the pathogens responsible for the infection vary with time, geography, and patient age.[5] 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.[6] 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.[7]

Information from laboratory based surveillance is important in determining the most common etiology of meningitis pathogens. It is further necessary for improving the clinical management of cases, guiding therapeutic decisions and for designing preventive strategies.[8] Information regarding changing trends in terms of etiology and antimicrobial susceptibility in particular region are essential for correct and timely management of meningitis. The study was done with an objective to know the different organisms responsible for meningitis and their antibiotic susceptibility patterns.

Material and methods

This was a retrospective study conducted at a tertiary care hospital in South India. The data was obtained from Microbiology laboratory using the records from March 2011 to March 2013. All the patients attending the Pediatric department with clinical signs of meningitis, aged 1 month to 12 years were included in the study. Cerebro-spinal fluid (CSF) samples were collected aseptically in sterile test tubes. The samples were processed for cell counts, Grams staining, culture on blood agar, chocolate agar and MacConkey agar. All culture plates suspected of bacterial and fungal organisms were incubated at 37^0C for 24–48 hours in 5% carbon dioxide environment and room temperature respectively.

All other bacteria isolates were identified using conventional biochemical methods including urease and indole production, citrate utilization, hydrogen sulphide gas production and fermentation of sugars. Any colonies observed were further processed and pathogens identified by standard microbiological techniques adapted from the WHO laboratory manual for diagnosing bacterial meningitis.[9] The culture plates were observed daily for presence of growth. The isolates were identified by standard techniques and antibiotic susceptibility tests were done against locally available antibiotics by using disk diffusion method in accordance with Clinical Laboratories Standards Institute (CLSI) guidelines.[10]

Antimicrobial susceptibility testing was done using modified Kirby-Bauer disk diffusion method for the following antibiotics. For Gram positive cocci the following antibiotics were tested- Ampicillin (10µg), Ciprofloxacin (5µg), Ofloxacin (5µg), Cefoxitin (30µg), Clindamycin (2µg), Oxacillin (1µg), Erythromycin (15µg), Linezolid (30µg) and Vancomycin (30µg). The antibiotics tested for Gram negative bacilli were Amikacin (30µg), Gentamicin (10µg), Chloramphenicol (30µg), Co trimoxazole (1.25/23.75µg), Ceftazidime (30µg), Ceftriaxone (30µg), Piperacillin (100µg), Piperacillin+tazobactam (100µg/10µg) and Imipenem (10µg).

Results

During the two year study, a total of 1095 CSF samples were studied. Out of these 209 were confirmed as bacterial meningitis based on Gram's staining and culture. The demographic data of the cases is shown in table 1.

Table 1: Demographic data of the cases

Variable	Number	Percentage
Gender		
Male	146	69.8
Female	63	30.1
Age		
1 month- 1 year	93	44.4
1-3 years	39	18.6
4-6 years	27	12.9
7-9 years	36	17.2
10-12 years	14	6.6

Maximum cases were from male and most common age group was 1 month-1year. The various organisms isolated are shown in table 2.

Table 2: Bacterial Isolated from CSF (n=209)

Organism	Number	Percentage
Gram positive (132)		
S. pneumoniae	66	31.5
S. pyogenes	9	4.3
CONS	15	7.1
S. aureus	24	11.4
Enterococci species	18	8.6
Gram negative (87)		
K. pneumoniae	38	18.1
P. aeruginosa	14	6.6
Acinetobacter species	3	1.4
E. coli	25	11.9
H. influenzae	3	1.4
Enterobacter species	4	1.9

CONS = Coagulase negative staphylococci

Most common Gram positive organism was *S. pneumoniae*, and most common Gram negative organism was *K. pneumoniae*

The antibiogram of Gram positive organisms is shown in table 3

Table 3: Antibiotic Susceptibility Pattern of Gram positive organisms (% resistant)

Antibiotic	SPN	SPY	CONS	*S. aureus*	*E. spp*
Ampicillin	67	78	86	87	78
Ciprofloxacin	77	55	73	79	55
Ofloxacin	60	44	60	71	50
Cefoxitin	57	44	47	37	39
Clindamycin	33	33	40	42	22
Oxacillin	35	22	27	42	28
Erythromycin	53	33	60	58	50
Linezolid	0	0	0	0	0
Vancomycin	0	0	0	0	0

SPN = *S. pneumoniae*, SPY = *S. pyogenes*, CONS = Coagulase negative staphylococi, E. spp = *Enterococci species*

Highest resistance was seen with Ampicillin and least with Linezolid and Vancomycin.

The antibiogram of Gram negative organisms is shown in table 4

Table 4: Antibiotic Susceptibility Pattern of Gram negative organisms (% resistant)

Antibiotic	KLB	PSU	ACT	*E. coli*	HIF	ETB
Amikacin	29	36	33	28	0	0
Gentamicin	37	36	33	36	0	25
Chloramphenicol	47	-	67	52	-	25
Co trimoxazole	39	43	-	52	-	-
Ceftazidime	37	36	0	28	0	0
Ceftriaxone	59	43	33	44	33	25
Piperacillin	-	29	-	12	0	0
PP-TZ	3	0	0	4	0	0
Imipenem	0	0	0	0	0	0

PP-TZ = Piperacillin+tazobactam, KLB = *K. pneumoniae*, PSU = *P. aeruginosa*, ACT = Acinetobacter species, HIF = *H. influenzae*, ETB = *Enterobacter species*

Highest resistance was seen with Chloramphenicol and least with Imipenem.

Discussion

Despite the availability of effective antibiotics, bacterial meningitis is still a major cause of morbidity and mortality in the pediatric age group. Acute bacterial meningitis is a medical emergency, which warrants early diagnosis and aggressive therapy. Most often therapy for bacterial meningitis is empirical, before the culture reports are available. The successful management of meningitis depends upon the identification of the types of organisms that cause the diseases and the selection of an effective antibiotic against the organism in question.[11]

In the present study, meningitis was common among the males and in age less than one year. Tis finding is similar with the other studies conducted in India.[5, 12] The most common organisms were Gram positive (63.1%). Among the Gram positive organism, most common organism was *S. pneumoniae* and among Gram negative organisms, *K. pneumoniae* was the most common organism (table 2). Other recent studies have reported *S. pneumoniae* and *K. pneumoniae* as the most common cause of meningitis.[13,14] In the present study, an important finding was that Neisseria meningitides was not isolated in any case *H. influenzae* was isolated in only three case. Reasons could be low incidence of the above mentioned pathogen in the present study area. Tiological pathogens do differ from region to region.[15]

Some authors have found high incidence of *H. influenzae* meningitis in the pediatric age group[12] while others have experienced a low incidence.[15, 16] It appears that *H. influezae* and *N. meningitidis* are not the common pathogen responsible for acute bacterial meningitis in south east Asia when compared with the western countries.[16] Another reason for low isolation pf Hib might be to introduction of Hib vaccine in immunization programme.

Regarding antibiogram, Gram positive organisms were resistant to commonly used antibiotics such as Ampicillin, Ciprofloxacin and Erythromycin (table 3). Not a single isolate was resistant to Linezolid and Vancomycin. Some studies[17] have reported Methicillin resistant staphylococcus aureus (MRSA), but MRSA was not isolated from the present study. Among the Gram negative organisms, high resistance was seen with Chloramphenicol and Ceftriaxone and least with Piperacillin+tazobactum and Imipenem (table 4).

Emergence of resistant bacterial strains to conventional antibiotics such as Chloramphenicol, Penicillin and Ampicillin have also been reported in other studies in Nigeria, Mumbai, and Trinidad[18] and is a alarming sign. Regional information in terms of etiology and antimicrobial susceptibility will not only help in timely management of meningitis but also for formulating hospital antibiotic guidelines.

Limitations of the study

This was a retrospective study; the sample size was small and was conducted in only one centre. Future studies should be prospective and multicentric.

Conclusion

Streptococcus pneumoniae and *Klebsiella pneumoniae* were the major pathogens responsible for bacterial meningitis in pediatric age group. There is a need for periodic surveillance of pathogens in ABM. Regular prevalence and antibiotic susceptibility studies will help to detect the change in causative organism of ABM and also help pediatricians in choosing an appropriate antimicrobial.

Conflict of interest: None

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