Study of Sociodemographic Characteristics, Clinical Profile and Pattern of Pathogens of Meningitis in Children Admitted in A Tertiary Level Medical College Hospital

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Abstract

Background: CNS Infection are likely to arouse tremendous anxiety in both the physician and the patients. It is one of the most potentially serious infections occurring in children and important cause of mortality and morbidity in worldwide.Laboratory surveillance of pathogen is crucial in formulating the empirical treatment guidelines. To evaluate sociodemographic characteristics, clinical profile and pattern of pathogens of meningitis in children.

Materials and methods : A descriptive study was carried out in paediatric Inpatient Department of Pediatric CMCH (Chittagong Medical College Hospital) Chattogram during the period of May 2013 to April 2014 whereHistory, clinical examination and CSF sample were obtained from 40 patients of suspected meningitis. Diagnosis was based on the clinical presentation and CSF analysis.

Results: In this study, out of 40 patient, 25 patients were diagnosed as bacterial meningitis and 15 patient were diagnosed as aseptic meningitis based on clinical features and CSF analysis. 20% Culture positive bacterial menigitis was found, S pneumonae was found the leading pathogen.Overall, mortality rate was 2.5 %.

Conclusion: Bacterial meningitis is a medical emergency. Making an early diagnosis and prompt treatment are lifesaving. For Starting early empirical treatment of meningitis, knowledge about the local pathogen is necessary.

Key words: Aseptic meningitis; Bacterial meningitis; CSF.

Introduction

Meningitisis a common clinical problem during infancy and childhood. It is one of the most potentially serious infections occurring in infant and older children and important cause of mortality and morbidity in worldwide.[1] Among the different etiology of meningitis, bacterial meningitis is associated with high mortality globally, especially in the very young and elderly.[2] The burden of disease from bacterial meningitis is higher in low resource setting with poor health infrastructure because of higher rates of malnutrition, generally poor living condition and inadequate access of preventive and curative services which may predispose individuals to infection and limit opportunities for optimal treatment.[2]

In many resource poor settings, where diagnostic facilities are scarce, unreliable, or unaffordable, patients presenting with meningoencephalitis are treated empirically rather than on the basis of definitive laboratory diagnosis.[2] In such setting data on the local causes of meningoencephalitis can assist clinicians in determining empiric treatment guidelines and assist policy makers and public health officials.[2,3]

There is different etiology of meningitis in neonate and children. Acute bacterial meningitis (10-20%) and aseptic or viral meningitis (82-90%) are two important and most common causes.[4]Meningitis is diagnosed by examination of CSF. Biochemistry, cytology, Gram stain, culture of cerebrospinal fluid is some common modalities of investigation.

Delay in distinguishing bacterial from aseptic maningitis may have irrevocable consequences. Quick diagnosis and effective treatment is the key to success. A typical case of bacterial meningitis without prior antibiotics may not creat any diagnostic problem, but prior treatment with inappropiate and inadequate antibiotics may cause sufficientalteration in biochemistry and cytology of Cerebrospinal Fluid (CSF) and organism may not get isolated from blood or CSF.[1] Moreover, the diagnostic dilemma in acute bacterial meningitis is due to large spectrum of signs and symptoms in childern.[1] However it is usual practice to start antibiotics before the complete laboratory result available.Majority of children who report to hospital, therefore, have already been treated with

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inadequate doses of antibiotics and present atypical features in CSF examination.[1] So, there is a dire need for the proffessional to have knowledge about Clinical profile and pattern of pathogens of meningitis in children.

In patients with CSF findings consistent with a diagnosis of bacterial meningitis, but in whom the CSF Gram stain and culture results are negative, there is no test that is definitive for or against the diagnosis of bacterial meningitis. In case of untreated bacterial meningitis, a CSF glucose concentration of <34mg/dl, a ratio of CSF to blood glucose of ≤0.23, a CSF protein concentration of high (<220mg/dl), a CSF leukocyte count of >2000 leukocyte/mm^3 with CSF neutrophil predominance with ≥99% certainity.[5]

The aim of this study was to document the sociodemographic characteristics, clinical profile and pattern of pathogens in suspected meningitis cases by performing culture and rapid test and to find out the mortality rate

Materials and methods

This descriptive cross- sectional study was carried out in inpatient department of Paediatrics, Chittagong Medical College Hospital, Chattogram during the period of May 2013 to April 2014.

Clinically suspected cases of meningitis cases of 8 weeks to 12 years who fulfilled the case definition were included in this study.His/her legal attendant was thoroughly informed about the aims, objectives and detail procedure of the study before examination.The samples were collected preferably within 24 hours of antibiotic therapy by purposive sampling.

After getting consent from legal guardian, clinical history and examinations was done. After all aseptic procedure lumber puncture was done to collect CSF. It was sent within one hour to the laboratory for cytological, biochemical, bacteriological and serological analysis. Related other investigations like CBC, Serum CRP were also been done. All relevant data were noted in the pre-tested data sheet. All data was checked and rechecked to avoid error.

All relevant information were recorded on a pre-tested data sheet. Data were analyzed by using SPSS- 19. Qualitative variables were analyzed by percentages and Chi square test, quantitave variables were expressed as mean and standard deviation. Sensitivity and specificity with positive and negative predictive value were analyzed by conventional formula. p value will be considered as statistically significant when it is less than 0.05. Necessary permission was taken from ERC of CMC before start the study.

Results

The study patients were categorized into 2 gorups. 25 (55%) patients were diagnosed as bacterial meningitis and 15(45%) patients were diagnosed as aseptic meningitis.

Among 40 patients around two third of patients were less than one year age group. Mean age was 29.30 ± 41.19 months. 55% patients came from rural area and 85% patients were completely immunised.

Table I Distribution of socio-demographic variables among the study subjects (n = 40)

Socio-demographic Variables		Frequency	Percentage (%)
Age	<1 year	24	24
	1-5 years	08	08
	>5years	08	08
Sex	Male	20	50.0
	Female	20	50.0
Inhabitance	Urban	18	45.0
	Rural	22	55.0
Immunization Status	Immunized	34	85.0
(According to EPI	Not Immunized	03	7.5
schedule)	Incompletely Immunized	03	7.5

Among them all the patient of meningitis had fever, Most (92.5%) of them had convulsion, about 40% of them had vomiting and 35 % was unconscious. On clinical examinationabout 17(42.%) patients was disoriented. Eight (20%) patients developed neck rigidity, Six (15%) patients had kernig sign, 8(32.5%) patients had buldge fontanelle.

Regarding CSf Finding 32.5% had turbid CSF and in 17.5% cases there was raised CSF pressure, 20% patient had reduced CSF sugar level, 15% cases had raised protein level and 17.5% patient had CSF leucocytosis. Among 25 patients of bacterial meningitis mean value of total WBC count, glucose and protein in CSF was found 400, 61 mg/dl, 159 mg/dl respectively.

Table II Distribution of CSF investigative findings among the study subjects (n = 40)

	CSF Investigations		Frequency	Percentage (%)
Physical Characters	Color	Turbid	13	32.5
		Clear	27	67.5
	Pressure	Raised	07	17.5
		Normal	33	82.5
Biochemistry	Sugar Level	Reduced	08	20.0
		Normal	32	80.0
	Protein Level	Increased	06	15.0
		Normal	34	85.0
Cytology	Leukocytosis	Yes	07	17.5
		No	33	82.5
	Total		40	100.0

Among 40 patients 25(62.5% of the patients were LPAT positive in which 8 patient were culture positive, 8(20%) patients those who were cultute positive, they were LPAT positive also. Only 2(5%) patients are gram stain positive.

Table III Distribution of various CSF investigative findings among the study subjects (n = 40)

CSF & Blood Investigations		Frequency	Percentage (%)
CSF Latex Agglutination Test	Positive	25	62.5
	Negative	15	37.5
CSF Culture	Positive	08	20.0
	Negative	32	80.0
CSF Bacteriology	Positive	02	5.0
Gram Staining	Negative	38	95.0

Among 25 cases of LPAT positive cases, S. Pneumonae (84%) is the leading pathogen, followed by N.meningitis 3 (12%) and H. influenzae 1(4%).

Table IV Distribution of bacterial isolates among 25 CSF LPAT +ve cases

Pathogen	no. of patients	percentage(%)
S. pneumonae	21	84%
N.meningitis	3	12%
H. influenzae	1	04%

Among 8 (32%) culture positive cases, S pneumonae was found in 7(87.5%) cases, N. meningitis was found in only 1 case(12.5%).
Among 2 (8%) Gram stain positive cases, in both cases S. pneumoniae were found.
When the latex agglutination test has taken as screening test, the sensitivity is found 95% but specificity is declined to 70%.

Table V Evaluation of CSF latex agglutination test as a screening test in respect to CSF culture

Diagnostic Tests	Validity of CSF Latex Agglutination Test				
	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Diagnostic Accuracy
CSF Culture	95.0 %	70.0 %	30.0 %	5.0 %	20.0 %

Among 40 cases of meningitis 90%(36) patient improved, 7.5%(3) cases developed residual disability and 2.5%(1) patient died.

Discussion

Infections involving the CNS are likely to arouse tremendous anxiety in both the parents and physitian bacause the mortality rates associated with these infections and the neurologic sequelae that may linger in those who recover[6].

Among the meningitis cases the viral meningitis is usually less severe and its frequency increases slightly in the summer months because of greater exposure to viruses.[7] Early clinical suspicion and implementation of appropriate antimicrobial therapy are critical to minimize adverse outcomes. CSF culture is considered the gold standard for bacterial meningitis, and bacterial isolation is important for antimicrobial susceptibility testing and molecular epidemiology.[8-10]

The result of this hospital based study showed that among meningitis cases, incidence bacterial meningitis (62%) is more than aseptic meningitis (38%). We found more bacterial meningitis than viral, because the study was done in a tertiary medical college hospital.This finding is consistent with finding of study done in Bangladesh by another worker.[11]

In this study, among the enrolled cases, up to 12 months of age was found to be the most vulnerable age group in children accounting for 60 % of total positive cases. This finding showed similarity with another worker (45%) in Khulna medical college hospital, Bangladesh andanother study done in Nepal.[12,13] The higher rate of meningitis in early age children may be because of the underdeveloped immune system.

The male to female ratio of the children was found 1:1 which is consistent with the finding of study done by another worker.[11,12]. The study done by Rasul CH et al and Belal Uddin et al found this ratio 1.4:1 and 1.1:1 respectively.[12,11]

This study showed that 34(85%) children were immunised completely as per EPI schedule, 3(7.5%) children were not immunised, and another 3(7.5%) children were incompletely immunised.

The clinical presentation of analysed in this study showed that fever (100%) and convulsion (92.5%) was the leading symptom and disorientation, neck rigidity, Kernig sign, buldge fontanelle was found in 42%, 20%, 15%, 32% cases respectively. Another worker observed convulsion in 45.4%, altered mental status in 59%, neck rigidity in 54%. The result of present study are not in agreement with that study[12]. This difference might be due to the age of children is below one year of age in 60% cases in current study.

The findings of this study clearly indicated that the protein level rise in both pyogenic (20-563 mg/dl) and aseptic (14-57mg/dl) meningitis but

more markedly rise in pyogenic meningitis. This result shows similarity with another worker which showed that protein level was 100-572 mg/dl in bacterial meningitis.[11]

Sugar level decreased in pyogenic meningitis (10-184mg/dl) but normal in aseptic meningitis (30-97mg/dl). This finding also consistent with study of same worker.[11]

Pathogen isolates by CSF culture are S. pneumonae (87.5%) and N. meningitidis (12.5%) and pathogen detected by LPAT are S. pneomonae 21(84%), N. meningitidis 3(12%), H. influenzae 1(4%). This difference is probably due to prior antibiotic therapy. Previous two Bangladeshi study showed that Belal Uddin found 44% S. pneumonae, 39% H. influenza and 9% N. meningitidis and Rafeza khanam found H. influenzae (40%) was the leading pathogen followedby S. pneumonae (35%), N. meningitides (5%).[11,14] But this study found only one H. influenzae cases who was incompletely vaccinated. This difference is due to introduction of Pentavalent vaccine (Which contain Hib vaccine) in EPI schedule from July 2009.[15]

In this study only 8 culture positive cases were found. When only culture positive cases are taken as gold standard the specificity was found 100% but the sensitivity declines to 47% and p value was found significant (0.014). Prior use of antibiotic reduces the culture positivity.

Bacteriological profile (Gram staining and culture result) of CSF facilitates the choice of antibiotic therapy. CSF culture sensitivities typically range between 70 to 90% with variation in case inclusion criteria, patient characteristics, laboratory practices and spectrum of bacterial pathogens likely contributing to the observed differences.[5,16] Gram staining, a mainstay of bacterial meningitis diagnosis, is widely available, inexpensive and rapid.[17] We got both of the tests are less sensitive due to prior antibiotic therapy. Some authors recommend using latex agglutination tests to detect bacterial capsular antigens in patients with suspected bacterial meningitis who have been receiving antibiotics at the time the lumbar puncture is performed. In our study latex agglutination test showed sensitivity of 95 % when compared with bacterial culture but here specificity was found only 32%. This may be due to that latex agglutination antigen detection test kits have several limitations, despite it is simple and rapid to perform.[18] However, a negative bacterial antigen test result does not rule out infection caused by a specific meningeal pathogen.[19]

The mortality rate we got here is 2.5% whereas this rate is found similar (4%-6%) with other studies.[20]

There is certainly no value in performing other test if culture or Gram stain of CSF demonstrate organism. As Culture report is available after 72 hour and Gram stain can be found positive 60-80% and this yield of CSF culture and Gram stain may be lower for patient who recieved prior antimicrobial therapy.[17,5] Delay in specific treatment for those cases, till the culture report were available will be devastating.[21] So, A local Bacteriological profile and antibiogram may help a lot in this circumstances.

Though we found 62% cases of bacterial meningitis, previous study showed that among meningitis cases only 20% cases were bacterial, rest 80-90% cases were aseptic meningitis which requir only supportive therapy as management.[4] The present study also suggest that a patient with any degree of CSF pleocytosis and raised protein level who has a positive CRP in the CSF should be treated presumptively for bacterial meningitis. Patients with low grade pleocytosis who have normal CSF glucose and protein and a negative Gram stain, cluture, LPAT and in whom the clinical picture is very suggestive of a viral etiology.

Sound clinical judgment combined with this antibiogramcan provide a rational basis for treatment decision in the management of bacterial meningitis.

Limitations

- The primary limitation of this study was that it is a hospital based study, done in a selected hospital.
- Adequate number of study subjects were not included due to limited resource.
- Prior antibiotic therapy was a limitation which reduce the yeild of bacterial culture and Gram stain.
- The inability to isolate virus was also another limitation in identifying the actual causative agent for viral meningitis.

Conclusion

The bacterial meningitis is abundant in infancy as revealed in the present study. S. Pneumonaeis the leading pathogen identified. Adding HIV (H. influenzae) vaccine in EPI schedule, curbs the antibiogram of meningitis. Making an early diagnosis and treatment are life saving.For starting early empirical treatment of meningitis, knowledge about the local pathogen is necessary. This study calls for the longitudinal surveillance for bacterial meningitis to document the real scenario regarding prevalent strains of bacterial pathogens.

Recommendations

- Early Diagnosis and treatment of meningitis to reduce complications.
- As S. Pneumonae is found as a leading pathogen, empirical treatment should be targeted to this pathogen.

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Contribution of authors

KN-Conception, acquisition of data, drafting & final approval.

MSA-Design, data analysis, drafting & final approval.

MJBAC-Data collection,k interpritation of data, critical revision & final approval.

NN-Interpritation of data, critical revision & final approval.

Disclosure

All the authors declared no competing interest.

References

1. Prasad CP,Nair BM, Kalghati AT. Childhood Bacterial meningitis and usefulness of C- reactive protein. MJAFI. 2005;61: 13-15.

2. Gurley ES, Hossain MJ, Montgomery SP et al. Etiology of Bacterial Meningitis in Bangladesh: Results from a Hospital Based Study. Am. J. Trop. Med. Hyg. 2009; 81(3): 475-483.

3. Kennedy WA, Chang SJ, Purdy K et al. Incidence of bacterial meningitis in Asia using enhanced CSF testing: Polymerase chain reaction, latex agglutination and culture. Epidemiol Infect. 2007; 135: 1217-1226.

4. Thomas V, Riaz AS, Qasim S.Cerebro Spinal Fluid Analysis in Childhood Meningitis, Oman Medical Journal. 2008;23(1).

5. Tunkel AR, Hartman BJ, Kaplan SL et al. Practice Guideline for the Management of Bacterial Meningitis. Infectious Disease Society of America (IDSA). CID. 2004;39:1267.

6. Brouwer MC, Tunkel AR, Van de Beek D. Epidemiology, diagnosis, and antimicrobial treatment of acute bacterial meningitis. Clin Microbiol Rev. 2010;23:467–492.

7. Meningitis in children. http://www.emedicinehealth.com/meningitis inchildren/articleem.htm.

8. Andersen J, Backer V, Voldsgaard P, Skinhoj P, Wandall JH. Acute meningococcal meningitis: Analysis of features of the disease according to the age of 255 patients. Copenhagen Meningitis Study Group. J Infect. 1997;34:227–235.

9. Bohr V, Rasmussen N, Hansen B, Kjersem H, Jessen O, Johnsen N, et al. 875 Cases of bacterial meningitis: Diagnostic procedures and the impact of preadmission antibiotic therapy. Part III of a three-part series. J Infect. 1983;7:193–1002.

10. Bryan JP, de Silva HR, Tavares A, Rocha H, Scheld WM. Etiology and mortality of bacterial meningitis in northeastern Brazil. Rev Infect Dis. 1990;12:128–135.

11. Uddin MB, Rahman M, Siddique AB. Usefulness of CSF C- Reactive Protein in Differentiating Bacterial and Aseptic Meningitis. TAJ. 2009;22(1):78-81.

12. Rasul CH, Muhammad F, Hossain JM, Ahmed KU, Rahman M. Acute Meningoencephalitis in Hospitalised Children in Southern Bangladesh, Malays J Med Sci. 2012; 19(2); 67-73.

13. Shrestha RG,Tandukar S, Ansari S, Subedi A, Shrestha A, Poudel R, Adhikari N, Basnyat SR, Sherchand JB. Bacterial meningitis in children under 15 years of age in Nepal. Shrestha et al. BMC Pediatrics. 2015;15:94. DOI 10.1186/s12887-015-0416-6.

14. Khanam R, Hanif M, Huque MM, Tawfique M, Ahmed ASM, Ahmed NU. Use of CSF CRP for the differentiation of bacterial meningitis from aseptic meningitis in children, 17th Biennial International conference Bangladesh Paeditric Association,17-18 Feb. 2012; Dhaka, Bangladesh.

15. Mollah MAH, Nahar N. Steps on to Paediatrics. 2nd ed. Dhaka. 2012;7:26.

16. Wu HM, Cordeiro SM, Harcourt BH, Carvalho M, Azevedo J, Oliveira TQ et al. Accuracy of real-time PCR, gram stain and culture for Streptococcus pneumoniae, Neisseria meningitidis and Haemophillus influenzae meningitis diagnosis. BMC Infect Diseases. 2013;13:26.

17. Harrison LH, Trotter CL,Ramsay ME. Global epidemiology of meningococcal disease. Vaccine. 2009; 27:51-63.

18. Jenkins P, Barnes RA, Coakley WT. Detection of meningitis antigens in buffer and body fluids by ultrasound-enhanced particle agglutination. J Immunol Methods. 1997;205:191–200.

19. Gray LD, Fedorko DP. Laboratory diagnosis of bacterial meningitis. Clin Microbiol Rev. 1992;5:130–145.

20. Kornelisse RF, Westerbeek CM, Spoor AB, van der Heijde B, Spanjaard L, Neijens HJ, et al. Pneumococcal meningitis in children: prognostic indicators and outcome. Clin Infect Dis. 1995;21:1390–1397.

21. Singh UK. et al. Cerebrospinal fluid C-reactive protein in the diagnosis of meningitis in children. Indian pediatrics. 1994;31: 939-941.