

# Evaluation of the Pathogens Causing Meningitis in Children <5 Years of Age: A study in a tertiary care hospital, Dhaka, Bangladesh

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## Abstract

During the last two decades, significant changes have taken place in the epidemiology of meningitis, especially due to the global availability and expanding use of Hib vaccines. We conducted an observational study with the aim was to isolate and identity of the pathogen causing meningitis in children under 5 years during January 2017 to December 2017 in Paediatrics department of Dhaka Shishu (Children) Hospital Dhaka, Bangladesh. Our study participants were clinically suspected cases of meningitis in children below 5 years of age admitted in the selected hospital. All the data were collected and recorded systematically in a questionnaire and entered into computer software SPSS (Statistical package for social sciences) version 20.0 edited and analyzed with plotted in graphs and tables. Sensitivity and specificity of Gram stain, CSF latex were also calculated. Main outcome measure (s): Results of CSF cell count, Gram stain, Culture, LAT and Blood culture were the main outcome variables. A total of 100 cases of suspected meningitis in the age group below 5 years comprised the study population. Majority of the patients belonged to  $\leq 12$  months. Male to female ratio was 1.6:1. The most common clinical presentation was fever (100.0%) with median duration of 2 days. Ninety six (96) patients had convulsion and the median duration of continuation of convulsion was 1 day. Thirty Eight patients had vomiting and median duration of continuation of vomiting was 1 day. A total of 100 clinically suspected cases of acute bacterial meningitis, laboratory confirmed cases were 36(36.0%), out of which 14(38.9%) cases were CSF culture positive, 10(27.8%) were Gram stain positive and 36(36.0%) were Latex agglutination test positive. Most frequently isolated organism were *Streptococcus pneumoniae* 34(94.4%). *Haemophilus influenzae* was isolated in 2 cases. The validity of test of serology (LAT) sensitivity was 100.0% and specificity was 74.4%, Gram stain sensitivity was 71.4% and specificity 100.0% to detect capsular polysaccharide antigen in CSF. In the conclusion, we can say Meningitis is more common during infancy and is more common in males. Fever, convulsion, vomiting and lethargy were the commonest symptoms. CSF culture is the 'Gold standard' and positive in 38.9% cases, but Latex agglutination test was 100.0% sensitive for detection of Antigen in CSF.

**Keywords:** Meningitis, Antigen detection, CSF.

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## INTRODUCTION

Meningitis is one of the most potentially serious infections in infants and children. It is associated with acute complications and risk of chronic morbidity [1]. Acute bacterial meningitis is seen more in children than in adults and it is caused by a variety of micro organisms; the most important among them are *Haemophilus influenzae*, *Neisseria meningitidis* and *Streptococcus pneumoniae* [2]. They are most commonly associated with bacterial meningitis globally accounting for almost 90% of reported cases between 2 months to 5 years of age [3]. CNS is normally sterile unless the barrier between brain and blood are broken or infection enters from outside. Meningitis is the

inflammation of the pia and arachnoid matter surrounding the brain and spinal cord [4]. Bacterial meningitis most commonly results from haematogenous dissemination of micro-organism from a different site of infection. Bacterial colonization in the nasopharynx with a potentially pathogenic micro organism is the usual source of the bacteremia [1]. The clinical symptoms and signs of bacterial meningitis in children vary depending on the age of the child and duration of disease. Non specific signs include abnormal vital signs such as tachycardia and fever, poor feeding, irritability, lethargy and vomiting. Signs of fulminant sepsis such as shock disseminated intravascular coagulation (DIC), purpuric rash and coma may be present and are more

common in meningococcal meningitis. Classical signs of meningitis such as nuchal rigidity, bulged fontanelle, photophobia and positive Kernig's and Brudzinski's sign may also be present. Seizure may be present in 20-30% of children with bacterial meningitis more commonly with *S. pneumoniae* and *H. influenzae* infection than *N. meningitidis* [5]. However, in early stage of the disease and in young children, the symptoms and signs are often non-specific. Fever may be absent up to 30% of individuals and 20-30% does not have signs of meningism at presentation. Previous antibiotic therapy may also mask the significance of the presenting illness [6]. No pathognomonic signs or symptoms will accurately diagnose the cause of meningitis. The etiological diagnosis mainly depends on CSF analysis and culture. Alternative methods of CSF study has been developed which may be useful in patients commenced with antibiotic therapy before lumbar puncture. Where culture is negative, detection of soluble bacterial antigen can help to reach a diagnosis. Latex agglutination test has been introduced for this purpose because it can detect comparatively very small quantity of antigen present in CSF. The most common meningeal pathogens are *H. influenzae* type b, *S. pneumoniae*, *E. coli*, Group B. *Strep.* and *N. meningitidis* are detected by LAT. The LAT can diagnose these specific bacterial pathogens and specific antibiotic therapy can be given to reduce the emergence of bacterial resistance [7]. Particularly when antibiotic treatment is already started and it has been suggested that such diagnostic techniques may be more sensitive than Gram staining or standard bacterial culture [8]. Latex agglutination test is very useful in the diagnosis of bacterial meningitis with sensitivity and specificity ranging from 95-100% [7]. Seizures occur more commonly with *S. pneumoniae* and *H. influenzae* infection. Signs of fulminant sepsis such as shock, DIC, purpuric rash and coma may present and are more common in meningococcal meningitis [5]. Incidence rates of *N. meningitidis* meningitis are generally highest in children <5 years of age and adolescents. *N. meningitidis* can also cause a severe bacteremia called meningococcaemia [9] in young children; the case-fatality rate for meningitis due to *H. influenzae* is generally higher than that for meningitis due to *N. meningitidis*. The case fatality rate for meningitis due to *S. pneumoniae* in children less than five years of age exceeds 73% in some parts of the world [10]. The mortality of untreated bacterial meningitis approaches 100% and even with optimum treatment mortality and morbidity might happen. Neurological sequel are relatively common in survivors of meningitis [11]. Sensorineural hearing loss, seizures, motor problems, hydrocephalus and mental retardation, as well as more subtle problems are observed in post meningitis

children [12]. Early clinical suspicion supplemented with CSF study to confirm meningeal inflammation and identification of organism helps in timely intervention and optimum outcome.

## OBJECTIVE

### General Objectives

- To evaluate the pathogens causing meningitis in children under 5 years in Bangladesh.

### Specific Objectives

- To detect capsular polysaccharide antigen in CSF by latex agglutination test.
- To do comparative evaluation of Gram stain, culture and Antigen detection in CSF.

## METHOD AND MATERIALS

We conducted an observational study with the aim to evaluate and identify the pathogens causing meningitis in children <5 years during January 2017 to December 2017 in Paediatrics Department of Dhaka Shishu (Children) Hospital Dhaka, Bangladesh. Our study participants were clinically suspected cases of meningitis in children below 5 years of age admitted in the selected hospital. All the data were collected and recorded systematically in a questionnaire and entered into computer software SPSS (Statistical package for social sciences) version 20.0 edited and analyzed with plotted in graphs and tables. Sensitivity and specificity of Gram stain, CSF latex were calculated. Main outcome measure (s): Results of CSF cell count, Gram stain, Culture, LAT and Blood culture are the main outcome variables. A total of One Hundred (100) cases of suspected meningitis in the age group below 5 years comprised the study population.

## RESULTS

An observational study with the aim to evaluate and identify the pathogens causing meningitis in children <5 years during January 2017 to December 2017 in Paediatrics Department of Dhaka Shishu (Children) Hospital Dhaka, Bangladesh. Our study participants were clinically suspected cases of meningitis in children below 5 years of age admitted in the selected hospital. In this study it was observed that majority (70.0%) patients belong to  $\leq 12$  months, all patients had fever and median duration was 2days. Ninety six (96) patients had convulsion with median duration 1day. Thirty eight (38) patients had vomiting and median duration was 1day. Total cell count range was 45 to 12000 cumm and median was 700. Among 36 positive cases Gram stain+LAT+ Culture identified 10 positive cases, LAT+ Culture identified 14 positive cases and LAT alone identified 12 cases.

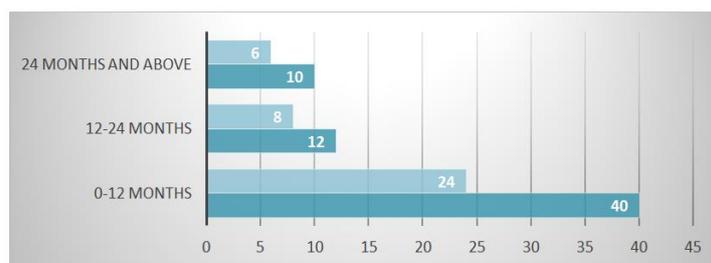


Fig-1: Distribution of the study patients by age &amp; Sex (n=100)

Table-1: Presenting symptoms with duration of the study patients (n=100)

Symptoms	Number	Duration of symptoms (days)	
		Median	Range (Min-Max)
Fever	100	2	1-5
Convulsion	96	1	1-3
Vomiting	38	1	1-2
Lethargy	35	1	1-2
Excessive Crying	11	1	1-2
Unconsciousness	7	1	1-1

Table-2: CSF findings of the study patients (n=100)

Investigation	Median	(Min/Max)
Total Cell Count/cu mm	700	45,12000
Neutrophil (%)	83	10,95
Lymphocyte (%)	16	5,90
Sugar(mg/dl)	45	6,58
Protin(mg/dl)	220	80,1000

Table-3: Laboratory confirmed cases of acute bacterial meningitis by different lab methods (n=36)

Tests	Number of Patients	%
Gram stain+LAT+ Culture	10	27.77
Culture+LAT	14	38.88
LAT	12	33.33
Total	36	100

Table-4: Comparison of CSF Gram stain and LAT with Culture (n=100)

Test	Culture		Total
	Positive	Negative	
Gram stain			
Positive	10	0	10
Negative	4	22	26
<b>Total</b>	14	22	36
<b>LAT</b>			
Positive	14	22	36
Negative	0	0	0
<b>Total</b>	14	22	36

Table-5: Organisms detected by Gram stain (n=10)

Organism seen in Gram Stain	Total cases	(%)
Gram positive cocci	8	80.0%
Gram positive bacilli	2	20.0%
	10	100%

## DISCUSSION

This observational study was carried out with an aim to evaluate the pathogens causing meningitis in children under 5 years in Bangladesh and to do a comparative evaluation of Gram stain, Culture and Antigen detection in CSF. A total of 100 patients,

clinically suspected cases of meningitis in children below 5 years of age admitted in Paediatrics department of Dhaka Shishu (Children) Hospital Dhaka, Bangladesh from January 2017 to December 2017, were included in this study. Children with history of fever, bulged fontanelle, convulsion, neck stiffness,

altered sensorium and meningeal signs were enrolled in this study. Any contraindication to do lumbar puncture, eg. Papilloedema, bleeding disorder, previously treated and referred from other hospitals were excluded from the study. Meningitis occurs in all ages but it is commonest in infancy. In this study it was observed that majority (70.0%) patients belong to  $\leq 12$  months, in this study all patients had fever their median duration was 2 days. Ninety six (96) patients had convulsion with median duration 1 day. Thirty eight (38) patients had vomiting and median duration 1 day. In present study CSF culture, Gram stain and Latex agglutination test was done. CSF culture is the "Gold standard" and these positive cases could be identified by other tests too, as being found here. Latex agglutination test is very useful in the diagnosis of bacterial meningitis with sensitivity and specificity ranging from 95-100% [7]. Seizures occur more commonly with *S. pneumoniae* and *H. influenzae* infection. Signs of fulminant sepsis such as shock, DIC, purpuric rash and coma may present and are more common in meningococcal meningitis. Incidence rates of *N. meningitidis* meningitis are generally highest in children <5 years of age and adolescents. *N. meningitidis* can also cause a severe bacteremia called meningococcaemia [9] in young children; the case-fatality rate for meningitis due to *H. influenzae* is generally higher than that for meningitis due to *N. meningitidis*. The case fatality rate for meningitis due to *S. pneumoniae* in children less than five years of age exceeds 73% in some parts of the world [10]. The mortality of untreated bacterial meningitis approaches 100% and even with optimum treatment mortality and morbidity might happen. Neurological sequelae are relatively common in survivors of meningitis [11]. Sensorineural hearing loss, seizures, motor problems, hydrocephalus and mental retardation, as well as more subtle problems are observed in post meningitis children [12]. Early clinical suspicion supplemented with CSF study to confirm meningeal inflammation and identification of organism helps in timely intervention and optimum outcome.

#### Limitations of the Study

The study population was selected from one selected hospital in Dhaka city; So that the results of the study may not reflect the exact picture of the country. The present study was conducted at a very short period of time. Small sample size was also a limitation of the study as it was conducted at a very short period of time. Although culture is the "Gold Standard" for diagnosis but it has limited value in case of low bacterial load in CSF.

#### CONCLUSION

This study was undertaken to isolate and identify the pathogen causing meningitis in children less than 5 years. Meningitis is more common during infancy and in males. Fever, Convulsion, Vomiting, and Lethargy were the commonest symptoms. Gram stain+LAT+ Culture could identify the agent in 27.77% cases.

Culture +Latex could identify 38.88% cases and LAT alone could identify 33.33%. *S. Pneumoniae* was the most common identified organism in this study. A collaboration of methods may help to diagnose bacterial meningitis. However, Majority of the cases are diagnosed on clinical ground.

#### RECOMMENDATION

Further studies can be undertaken in different places by including a large number of meningitis patients.

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