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### RESEARCH ARTICLE

#### CLINICAL PRESENTATION OF ACUTE BACTERIAL MENINGITIS AND CSF ANALYSIS OF ATTENDING OPDPATIENTS IN A TERTIARY CARE HOSPITAL KANPUR, INDIA

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#### Abstract

**Background:** Meningitis is an infection of the Meninges. Generally caused by Viral, Bacterial and Fungal Pathogens. Viral Meningitis is less severe and heals without specific treatment; whereas Acute Bacterial Meningitis (ABM) can be relatively severe and affect in internal illness. Acute Bacterial Meningitis (ABM) is a prime reason for loss of life and incapacity worldwide. Aim of this study is play important role in the diagnosis and more accurate treatment of patient.  
**Method:** In this study, all age groups were enrolled at one tertiary care hospital between November 2022 and April 2024. A total of 147 CSF clinically suspected Meningitis samples were submitted for analysis.  
**Result:** During the study, A total of 147 CSF samples were studied. Of these, 18 were identified as bacterial meningitis on the basis of Gram's staining and cultures, with an Incidence of (12.24%). Acute bacterial meningitis was more frequent in paediatric patients than in adults. Gram-positive bacteria were the most common Organism, accounting for (77.77%) of the total. The male and female ratio among all Culture Positive cases was (1.57:1).

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#### Introduction:

Meningitis is a Veritably Serious infection of the meninges that compass the brain and spinal cord generally caused by viral, bacterial and fungal pathogens. It is important to know whether meningitis is caused by a contagion or bacteria because the inflexibility of the illness and the treatment are different for them. Viral meningitis is generally less severe and heals without specific treatment, whereas Acute bacterial meningitis (ABM) can be relatively severe and affect in internal illness learning disabilities and death if left undressed in opinion and inauguration of treatment can lead to poor outcome of the complaints.<sup>[1,2]</sup> Meninges are formed by three layer membranes that are primarily known as wrappers of the brain, They correspond of Dura mater, arachnoid and pia mater. The dura mater or pachymeninx (thick) is the external membrane and forms a sac that envelops the other meningeal layers, It surrounds and supports the dural venous sinuses and it reflects in three infoldings, the first separating the two components of the cortex (falx cerebri), the alternate between the cerebellum and the occipital lobe (tentorium cerebelli and falx cerebelli) and the third covering the pituitary gland and the sella turcica. The leptomeninges (lepto- thin) are the inner membranes formed by two layers the external is named arachnoid (arachnoid spider) and the inner pia mater (pia- tender). The arachnoid is linked to the pia by arachnoid trabeculae that gauge

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the subarachnoid space filled with Cerebrospinal fluid (CSF) produced by choroid plexus.<sup>[3]</sup> In the year of 2014-15 Bacterial meningitis were proven to be more Severe and may also lead to Fetal life-threatening conditions as this bacterial meningitis had potent to at least 50,000 deaths due to meningococcal infections out of 5,00,000 cases, every year about millions of bacterial meningococcal infection was reported out of which at least 1,35,000 of them may lead to life threatening fetal conditions.<sup>[5,6]</sup> Acute Bacterial Meningitis is a prime reason for loss of life and incapacity worldwide, it impacts over a million human being yearly, with better occurrence amongst growing international location and in precise geographic areas.<sup>[4]</sup> In India, meningococcal disease is endemic comparatively then other etiological agents are latterly Approaching trains all acute bacterial meningitis (ABM) in recent years.<sup>[7]</sup> Although the rate of disease identical with meningitis is lower than any other main cause of childhood mortality.<sup>[8]</sup> The increased case of mortality rate and neurological sequels in survivors Result in appreciable emotional and financial Burden on the people and present a major challenge to the health care management system in financial and human resources.<sup>[8]</sup> There is a most important for a regular review of acute bacterial meningitis (ABM) in all over world.<sup>[2]</sup> Since the disease-causing agent responsible for the infection vary with time, geography and patient's age, the level of awareness is increased availability and uses of vaccine may also reflect as a change in epidemiological pattern of these pathogens.<sup>[2,9]</sup> There are 3 primary Organism that account the over 90% of the world's case of meningitis. these are Neisseria meningitidis, Streptococcus pneumoniae and Haemophilus influenzae type b.<sup>[10,11]</sup>

## Materials and Methods:

### Selection of Patients:

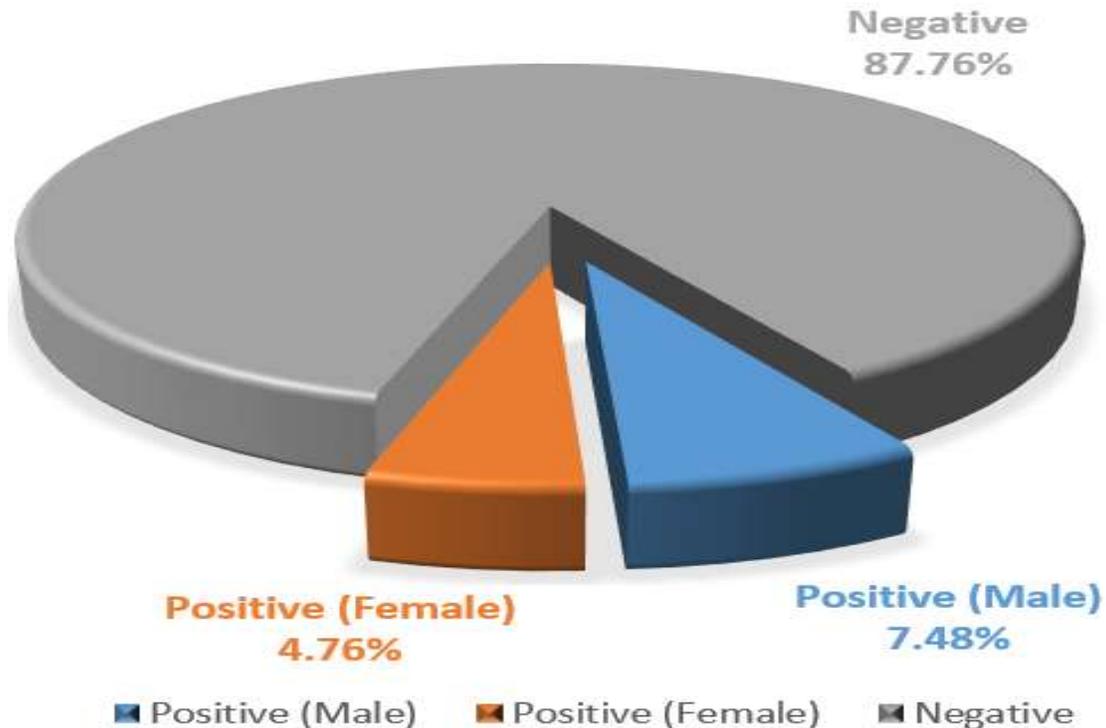
Observational study were conducted in department of microbiology school of health science (CSJMU Kanpur) Eighteen-months period (November 2022-April 2024), total 147 patients diagnosed as acute bacterial meningitis presented to G.S.V.M. medical college, Kanpur and School of health sciences, C.S.J.M. University Kanpur. Patients were subjected to through clinical examination with special preponderance on symptoms of fever, headache, vomiting, irritability, neck rigidity, skin rash were assessed.

### Sample collection:

The Cerebrospinal fluid (CSF) specimens were collected by medical officers in a sterile tube. The volume and gross appearance such as consistency, presence of blood and the colour of Cerebrospinal fluid (CSF) were noted. Cerebrospinal fluid (CSF) specimen greater than 1 ml was centrifuged at the rate of 2,500 revolutions per minute (rpm) for 10 minutes to concentrate if any organisms were present. The sediment were used for culture as well as for Gram staining. All the specimens were collected from the patients of a single tertiary care hospital and thus, the specimens were transported to the laboratory within half an hour. Cerebrospinal fluid (CSF) specimen was inoculated in Mac-Conkey agar (MA), Blood agar (BA) and Chocolate agar (CA) plates. The MA and BA plates were incubated overnight at 37 °C aerobically and the Chocolate agar (CA) plates were incubated up to 48 hours at 37 °C in 5 % CO<sub>2</sub> atmosphere (such as in a CO<sub>2</sub>-incubator or a candle-jar) which improved growth of capnophilic bacteria. The Bacterial growth obtained was examined for colonial as well as Gram Staining characteristics and identification was done following standard microbiological methods recommended by Clinical and Laboratory Standards Institute (CLSI).

## Result:

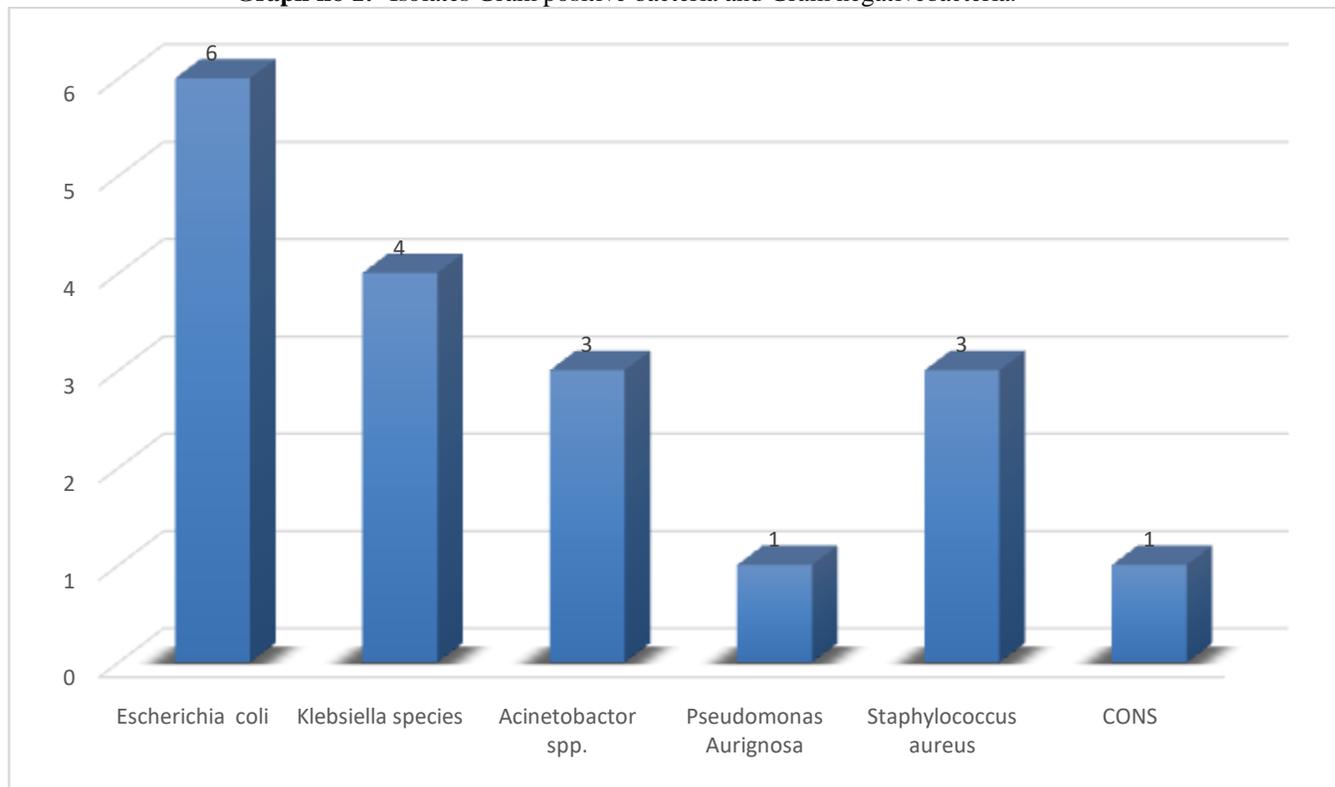
During the study period; A total of 147 Cerebrospinal fluid (CSF) Samples were included for this study. Out of these 18 were found confirmed as Acute Bacterial Meningitis (ABM) based on Gram Staining and Culture Result showing 12.24% Positive rate. The Male and Female ratio among all Culture Positive cases was 1.57:1 as show in table 1.

**FIGURE. 1****Figure 1:-** Distribution of Microorganism among Positive cases of ABM.

Among 18 Culture Positive cases, 11 (61.11%) were Male and 07 (38.89%) Female and most common age group was 0-10 years (50%). Out of total 18 positive cases 09 (50%) belong to 0 to 10 years of age group follows as 11 to 20; 01 (5.55%), 21 to 30 years; 3 (16.66%), 31 to 40 years; 0 (0%), 41 to 50 years; 0 (0%), 51 to 60 years; 2 (11.11%) and > 60 years; 03 (16.66%). The age and sex demographical distribution was shown in table 1. Most common clinical presentation was the fever (94.44%), vomiting and nausea (83.33%), following the headache (83.33%), irritability (61.11%), neck rigidity (77.77%), skin rash (11.11%) were observed. Out of 18 isolates, Gram positive bacteria 04 (22.22%) and gram negative 14 (77.77%) as shows.

**Table1:-** Age and Sex wise Demographical Distribution of Suspected ABM cases.

Age group (years)	Male (94)	Positive (11)	% of positivity	Female (53)	Positive (07)	% of positivity
0-10	(59)	(03)	(5.08%)	(37)	(06)	(16.21%)
11-20	(12)	(0)	(0%)	(09)	(01)	(11.11%)
21-30	(08)	(03)	(37.5%)	(02)	(0)	(0%)
31-40	(05)	(0)	(0%)	(02)	(0)	(0%)
41-50	(01)	(0)	(0%)	(0)	(0)	(0%)
51-60	(03)	(02)	(66.66%)	(02)	(0)	(0%)
>60	(06)	(03)	(50%)	(01)	(0)	(0%)

**Graph no 1:-** Isolates Gram positive bacteria and Gram negativebacteria.

The most common pathogens among 14 Gram Negative Bacteria were Escherichia coli, 06 (33.33%) predominant in all age groups followed by Klebsiella species, 04 (22.22%), Acinetobactorspecies, 03 (16.66%) and Pseudomonas auroginosa, 01 (5.55%). Among 04 (22.22%) Gram Positive microorganisms, Staphylococcus aureus 03 (16.66%) and Coagulase Negative Staphylococcus(CONS) 01 (5.55%). Antimicrobial Susceptibility Pattern to different groups of Antimicrobials is given in Table 2. All the Gram Positive Bacteria were highly sensitive to Gentamicin and Linezolid while Amoxicillin, Erythromycin, Vancomycin, Teicoplanin, Tetracycline and Azithromycin were less Sensitive drug in Staphylococcus aureus and Amoxicillin, Teicoplanin were sensitive drug in Coagulase Negative Staphylococcus (CONS).

**Table 2:-** Antibiotic Sensitivity Pattern in Gram Positive Isolates.

DRUGS	Staphylococcus aureus (03)		CONS(01)	
	Sensitive	Resistant	Sensitive	Resistant
<b>Ampicillin</b>	(0%)	(100%)	(0%)	(100%)
<b>Amoxicillin</b>	(66.6%)	(33.3%)	(100%)	(0%)
<b>Cefoxitin</b>	(0%)	(100%)	(0%)	(100%)
<b>Erythromycin</b>	(66.6%)	(33.3%)	(0%)	(100%)
<b>Co-trimoxazole</b>	(0%)	(100%)	(0%)	(100%)
<b>Gentamicin</b>	(100%)	(0%)	(100%)	(0%)
<b>Ciprofloxacin</b>	(0%)	(100%)	(0%)	(100%)
<b>Vancomycin</b>	(66.6%)	(33.3%)	(0%)	(100%)
<b>Teicoplanin</b>	(66.6%)	(33.3%)	(100%)	(0%)
<b>Tetracycline</b>	(66.6%)	(33.3%)	(0%)	(100%)
<b>Doxycycline</b>	(0%)	(100%)	(0%)	(100%)
<b>Linezolid</b>	(100%)	(0%)	(100%)	(0%)
<b>Chloramphenicol</b>	(0%)	(100%)	(0%)	(100%)
<b>Levonadifloxacin</b>	(0%)	(100%)	(0%)	(100%)
<b>Azithromycin</b>	(66.6%)	(33.3%)	(0%)	(100%)
<b>Clindamycin</b>	(0%)	(100%)	(0%)	(100%)

**Table03:-** Antibiotic SensitivePattern in Gram Negative Isolates.

DRUGS	Escherichia coli (06)		Acinetobactor species(03)		Klebsiella species (04)		Pseudomonas auroginosa (01)	
	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Resistant
Ampicillin	(0%)	(100%)	(0%)	(100%)	(0%)	(100%)	(0%)	(100%)
Amoxicillin	(16.6%)	(83.4%)	(0%)	(100%)	(25%)	(75%)	(0%)	(100%)
Piperacillin/tazobactam	(33.3%)	(66.6%)	(33.3%)	(66.6%)	(25%)	(75%)	(0%)	(100%)
Ceftriaxone	(16.6%)	(83.4%)	(0%)	(100%)	(0%)	(100%)	(0%)	(100%)
Cefoperazone/sulbactam	(16.6%)	(83.4%)	(66.6%)	(33.3%)	(25%)	(75%)	(0%)	(100%)
Ceftazidime	(16.6%)	(83.4%)	(0%)	(100%)	(75%)	(25%)	(0%)	(100%)
Clavulanic acid	(16.6%)	(83.4%)	(0%)	(100%)	(50%)	(50%)	(0%)	(100%)
Cefotaxime	(16.6%)	(83.4%)	(0%)	(100%)	(0%)	(100%)	(100%)	(0%)
Cefepime	(16.6%)	(83.4%)	(0%)	(100%)	(25%)	(75%)	(0%)	(100%)
Cefuroxime	(16.6%)	(83.4%)	(0%)	(100%)	(50%)	(50%)	(0%)	(100%)
Ciprofloxacin	(16.6%)	(83.4%)	(0%)	(100%)	(0%)	(100%)	(100%)	(0%)
Co-trimoxazole	(16.6%)	(83.4%)	(0%)	(100%)	(0%)	(100%)	(0%)	(100%)
Gentamicin	(33.3%)	(66.6%)	(0%)	(100%)	(0%)	(100%)	(0%)	(100%)
Amikacin	(16.6%)	(83.4%)	(0%)	(100%)	(75%)	(25%)	(0%)	(100%)
Imipenem	(16.6%)	(83.4%)	(0%)	(100%)	(25%)	(75%)	(0%)	(100%)
Meropenem	(16.6%)	(83.4%)	(0%)	(100%)	(50%)	(50%)	(0%)	(100%)
Ertapenem	(0%)	(100%)	(0%)	(100%)	(25%)	(75%)	(0%)	(100%)
Tigecycline	(66.6%)	(33.3%)	(66.6%)	(33.3%)	(75%)	(25%)	(100%)	(0%)
Aztreonam	(33.3%)	(66.6%)	(66.6%)	(33.3%)	(25%)	(75%)	(0%)	(100%)
Minocycline	(0%)	(100%)	(100%)	(0%)	(25%)	(75%)	(0%)	(100%)
Levofloxacin	(0%)	(100%)	(0%)	(100%)	(25%)	(75%)	(0%)	(100%)
Ampicillin sulbactam	(0%)	(100%)	(0%)	(100%)	(0%)	(100%)	(0%)	(100%)
Fosfomycin	(16.6%)	(83.4%)	(0%)	(100%)	(25%)	(75%)	(0%)	(100%)
Tetracycline	(0%)	(100%)	(0%)	(100%)	(0%)	(100%)	(0%)	(100%)
Azithromycin	(16.6%)	(83.4%)	(0%)	(100%)	(0%)	(100%)	(0%)	(100%)

**Gram Negative Microorganism:**

In the study, Gram negative bacteria the most common isolate was Escherichia coli, against this pathogen, Tigecycline (66.6%) was highly Sensitive while Piperacillin Tazobactam (33.3%), Gentamycin (33.3%), Aztreonam (33.3%), Amoxicillin (16.6%), Ceftriaxone (16.6%), Cefoperazone sulbactam (16.6%), Ceftazidime (16.6%), Clavulanic acid (16.6%), Cefotaxime (16.6%), Cefepime (16.6%), Ciprofloxacin (16.6%), Co-trimoxazole (16.6%), Amikacin (16.6%), Imipenem (16.6%), Meropenem (16.6%), Fosfomycin (16.6%), Azithromycin (16.6%) was less Sensitive. The Klebsiella species Showed lowest sensitivity towards Amoxicillin (25%), Piperacillin Tazobactam (25%), Cefoperazone sulbactam (25%), Cefepime (25%), Imipenem (25%), Ertapenem (25%), Aztreonam (25%), Minocycline (25%), Fosfomycin (25%), Clavulanic acid (50%), Meropenem (50%), Cefuroxime (50%) whereas their Sensitive to Ceftazidime (75%), Amikacin (75%), Tigecycline (75%). Other Gram negative bacteria like Acinetobacter species. In which Minocycline (100%) highly Sensitive and less Sensitive against Cefoperazone sulbactam (66.6%), Tigecycline (66.6%), Aztreonam (66.6%), Piperacillin Tazobactam (33.3%). In case of Pseudomonas auroginosa, it was Sensitive to Cefotaxime, Ciprofloxacin, Tigecycline.

**Discussion:-**

In this study, Bacterial Meningitis was Confirmed in only 18 (12.24%) patients out of 147 Cerebrospinal fluid (CSF) samples based on Gram stain and culture results. Several studies in India have reported culture-negative meningitis cases with low Cerebrospinal fluid (CSF) culture positivity rates ranging from 6 to 50%.<sup>(13,14)</sup> The study found that men were 1.57 times more likely to suffer from Acute Bacterial Meningitis (ABM) than women. The male

predominance observed in this infection has also been reported in several previous studies. This study also reflects that Acute Bacterial Meningitis (ABM) is more common in pediatric patients than in adults, which is comparable to other studies on Bacterial Meningitis in India.<sup>(8,15)</sup> Clinical presentation including the fever (94.44%), vomiting and nausea (83.33%), following the headache (83.33%), irritability (61.11%), neck rigidity (77.77%) and skin rash (11.11%). In our study, the most common Microorganisms were Gram-Negative 14 (77.77%) and Gram-Positive 04 (22.22%). Among all the Microorganisms Isolated, *Escherichia coli* was the most common Microorganism compared to other microorganisms causing Acute Bacterial Meningitis (ABM). The other Important Pathogens causing Acute Bacterial Meningitis (ABM) in this study were *Klebsiella* species, *Acinetobacter* species, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, Coagulase negative staphylococcus (CONS).

### Conclusion:-

In this study, Bacterial pathogens were Isolated from 147 samples, with an Isolation rate of 12.24%. The Male to Female ratio was 1.57:1, indicating that there were more Males. Although *Escherichia coli* was the most common Bacterial Pathogen in all age groups in this study, the spectrum of Microorganisms causing Acute Bacterial Meningitis (ABM) varied by time, region, and patient age. Clinical signs of Meningitis are not always reliable, so Laboratory support is essential for early Diagnosis. This study could play an Important role in the diagnosis and more accurate treatment of patients with acute Bacterial Meningitis. Routine prevalence and Antibiotic Susceptibility studies can help improve Antimicrobial stewardship and minimize the emergence and spread of Antimicrobial Resistance. Additionally, it can help Clinicians select appropriate empiric Antimicrobial agents. Therefore, Continued surveillance with more detailed studies is required to determine the true extent of the problem and the extent of Disease and Antimicrobial Resistance caused by these Pathogens.

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