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Bacteriological Profile Of Meningitis In The Pediatric Population

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Abstract:
***Background**: In the pediatric population, particularly in neonates, bacterial meningitis is a major cause of mortality and long-term neurological impairment. The objective of this study was to evaluate the bacteriological profile in terms of pathogen frequency and antibiotic sensitivity pattern in the cerebrospinal fluid (CSF) samples of the pediatric population.*
***Materials and Methods**: CSF samples of pediatric patients aged 0-15 years were subjected for bacteriological analysis. In this study, 919 CSF samples, of 563 (61.26%) male and 356 (38.73%) female patients were processed and 71 samples of CSF (7.72%) showed bacterial growth suggestive of meningitis.*
***Results**: The common etiological agents were Gram negative organisms (70.42%) followed by Gram positive organisms (39.57%) and they include Acinetobacter species (35.13%), Enterococcus species (15.49%), Klebsiella pneumoniae (12.67%), Escherichia coli (9.8%), Staphylococcus aureus (7.04%) and Streptococcus species (7.04%). No fungal etiology was found. Acinetobacter species were the most susceptible to Minocycline (92.3%), but resistance was shown by other drugs. Enterococcus species, Staphylococcus aureus, and Streptococcus species were sensitive to Linezolid (100%), Klebsiella pneumoniae to Amikacin (44.4%), Escherichia coli to Gentamicin and Imipenem (71.42%).*
***Key Word**: CSF, Meningitis, Antibiotic sensitivity pattern*

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I. Introduction

Meningitis is an inflammation of the subarachnoid space and the leptomeninges that surround the brain and spinal cord [1, 2]. Out of all the various types of meningitis, bacterial meningitis has the biggest worldwide burden and is a major cause of mortality and chronic neurological impairment in children [2, 3,4,5,6,7,8,9]. Meningitis incident cases showed an increasing trend as per 2016 Global Burden of Disease (GBD) Study, cases increasing from 2.50 million in 1990 to 2.82 million in 2016 [10]. The "gold standard" for diagnosing meningitis is cerebrospinal fluid (CSF) culture, and in order to rationalize treatment, it's critical to determine the culprit microorganism's susceptibility [11, 12]. Antimicrobial therapy is typically initiated based on presumptive treatment, which is based on the antibiotic susceptibility pattern and etiology of the most frequent infections in a given geographical area [1,2,4,5]. Choosing the best pharmacological therapy for patients can be aided by understanding the most prevalent etiological agents and their antibiogram patterns [12]. Hence, it is crucial to understand the present microbial profile, their antibiogram pattern, and whether it is altering from past years [11]. The objective of this study was to evaluate the bacteriological profile in terms of pathogen frequency and antibiotic sensitivity (AST) pattern in the Cerebrospinal fluid (CSF) samples of pediatric patients.

II. Material And Methods

A Hospital-based Retrospective study was conducted from June 2022 to June 2023 at GMC, Aurangabad. All pediatric patients aged 0-18 years admitted to the ward and ICU with suspected meningitis were included.

Study Design: Hospital-based Retrospective study.

Study Location: This was a tertiary care teaching hospital based study done in Department of Microbiology, Government medical college, Aurangabad, Maharashtra, India.

Study Duration: June 2022 to June 2023.

Sample size: All pediatric CSF samples with suspected meningitis received in the lab during the study period.

Inclusion criteria: All CSF samples of suspected meningitis patients aged 0 to 18 years admitted in the pediatric inpatient department of our hospital were included.

Exclusion criteria: Unlabelled samples, samples with delayed transportation and contaminated samples**.**

Procedure methodology:

All CSF samples collected from the pediatric population with suspected meningitis were sent to the bacteriology section in the microbiology department for analysis. A total of 919 CSF samples were collected in sterile containers and sent to the lab without any delay. CSF samples received in the lab were processed as per Standard Operating Guidelines. Samples were subjected to direct microscopy and Gram staining for identification of pus cells, red blood cells, and microorganisms. Samples were inoculated on chocolate agar, blood agar, and MacConkey agar, followed by overnight incubation at 37 °C. Culture readings were done the next day, and samples without culture growth were reported as sterile. Out of 919 CSF samples received, 848 were identified as sterile samples. The growth on the agar plates was identified using conventional methods including Gram staining, hanging drop motility, biochemical reactions, and automated machines including vitek 2 (biomeriux/vitek-2 compact 60 system) and maldi-tof (biomeriux-vitek ms). Antimicrobial susceptibility testing (AST) was done for the identified organisms as per Clinical and Laboratory Standards Institute (CLSI M100-32edition) guidelines[13]. Kirby Bauer Disc Diffusion Method and vitek 2 (biomeriux/vitek-2 compact 60 system) were used for antimicrobial susceptibility testing (AST). A standard 0.5 McFarland inoculum was prepared for each bacterial isolate and inoculated on Muller-Hinton agar by the lawn culture method, followed by overnight incubation at 37 °C. For the AST of Streptococcus species, blood agar plates were used. AST in the vitek 2 system was done as per the manufacturer's guidelines. AST readings were done the next day, and sensitivity patterns were identified for each isolated organism.

III. Result

The highest frequency of isolated organisms among the age group 0 - 1 yrs were Acinetobacter species followed by Enterococcus species and Klebsiella pneumoniae. Among 1 – 18 yrs frequently isolated organisms included Acinetobacter species followed by Klebsiella pneumoniae and Escherichia coli (Table 1).

Table no 1 shows distribution of organisms according to the age group. Common isolated organisms among age group 0-1 years included Acinetobacter species 16 (32.65%), Enterococcus species 10 (20.40%), Klebsiella pneumoniae 6 (12.24%), Streptococcus species 4 (8.16%), Escherichia coli 4 (8.16%), Staphylococcus aureus 3 (6.12%), Pseudomonas species 2 (4.08%),and Others 4 (8.16%). Common isolated organisms among age group 1-18 years included Acinetobacter species 10 (45.45%), Klebsiella pneumoniae 3 (13.63%), Escherichia coli 3 (13.63%), Pseudomonas species 2 (9.09%), Staphylococcus aureus 2 (9.09%), Enterococcus species 1 (4.5%) and Streptococcus species 1 (4.5%).

Table no 1: Shows distribution of organisms according to the age group.

Age	Number Tested	Culture Positive	Culture Negative	Organisms Isolated
0-1 Years	657 (71.49%)	49 (7.45%)	608 (92.54%)	1. Acinetobacter Species 16 (32.65%) 2. Enterococcus Species 10 (20.40%) 3. Klebsiella Pneumoniae 6 (12.24%) 4. Streptococcus Species 4 (8.16%) 5. Escherichia Coli 4 (8.16%) 6. Staphylococcus Aureus 3 (6.12%) 7. Pseudomonas Species 2 (4.08%) 8. Others 4 (8.16%)
1-18 Years	262 (28.50%)	22 (8.39%)	240 (91.60%)	1. Acinetobacter Species 10 (45.45%) 2. Klebsiella Pneumoniae 3 (13.63%) 3. Escherichia Coli 3 (13.63%) 4. Pseudomonas Species 2 (9.09%) 5. Staphylococcus Aureus 2 (9.09%) 6. Enterococcus Species 1 (4.5%) 7. Streptococcus Species 1 (4.5%)
Total	919 (100%)	71 (7.72%)	848 (92.27%)	

Antibiotic susceptibility tests revealed that Acinetobacter species had the highest level of sensitivity to Tetracycline and Minocycline (Fig 1). Aztreonam, Amikacin, Piperacillin tazobactam, and Tobramycin demonstrated the maximum sensitivity in Pseudomonas species (Fig 2). Klebsiella pneumoniae was most susceptible to Amikacin, Gentamicin, and Meropenem (Fig 3). For Escherichia coli it was Gentamicin and

Imipenem (Fig 4). All isolated Gram-negative bacteria were sensitive towards Colistin.Gram-positive isolates were most susceptible to Linezolid, Vancomycin, and Doxycycline (fig 5, 6, 7). Methicillin sensitivity was present in 80% of the Staphylococcus aureus isolates. Conversely, 4 ofthe 11 Enterococcus species that were isolated were found to beVancomycin-resistant strains. Acinetobacter species exhibited the highest frequency of multidrug-resistant strains (Table 2).

Figure no 1 shows the percentage of antibiotic susceptibility of Acinetobacter species. Acinetobacter species showed maximum sensitivity towards Colistin, Minocycline and Tetracycline. Maximum resistance was towards Ceftazidime, Imipenem/Meropenem and Ciprofloxacin

Figure no 1: Percentage of antibiotic susceptibility of Acinetobacter species

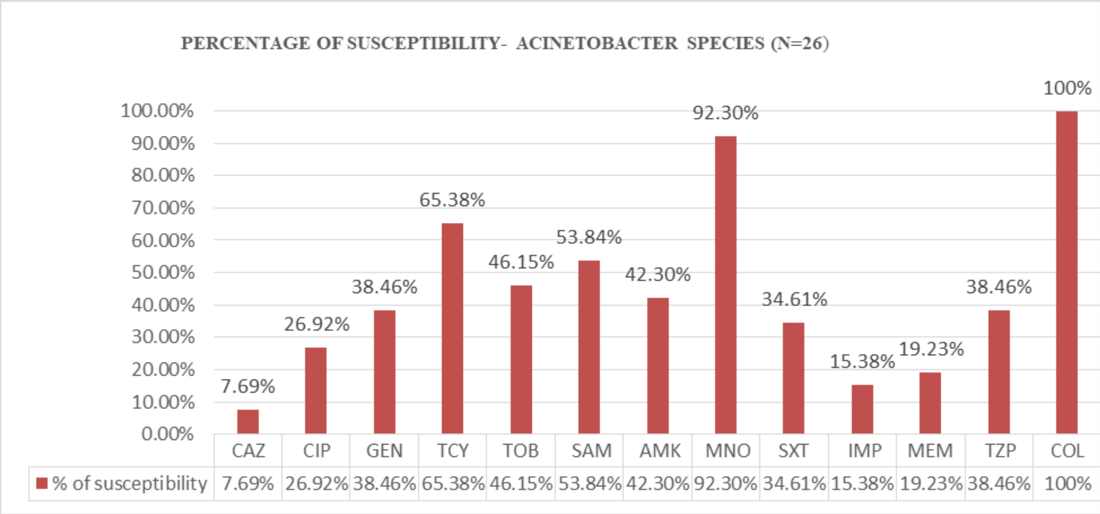

Figure no 2 shows the percentage of antibiotic susceptibility of Pseudomonas species.Pseudomonas species were highest sensitive towards Colistin, Tobramycin/Amikacin, Piperacillin/Tazobactum and Aztreonam. Maximum resistance was shown by Ceftazidime, Ciprofloxacin, Gentamicin and Imipenem/ Meropenem

Figure no 2 : Percentage of antibiotic susceptibility of Pseudomonas species.

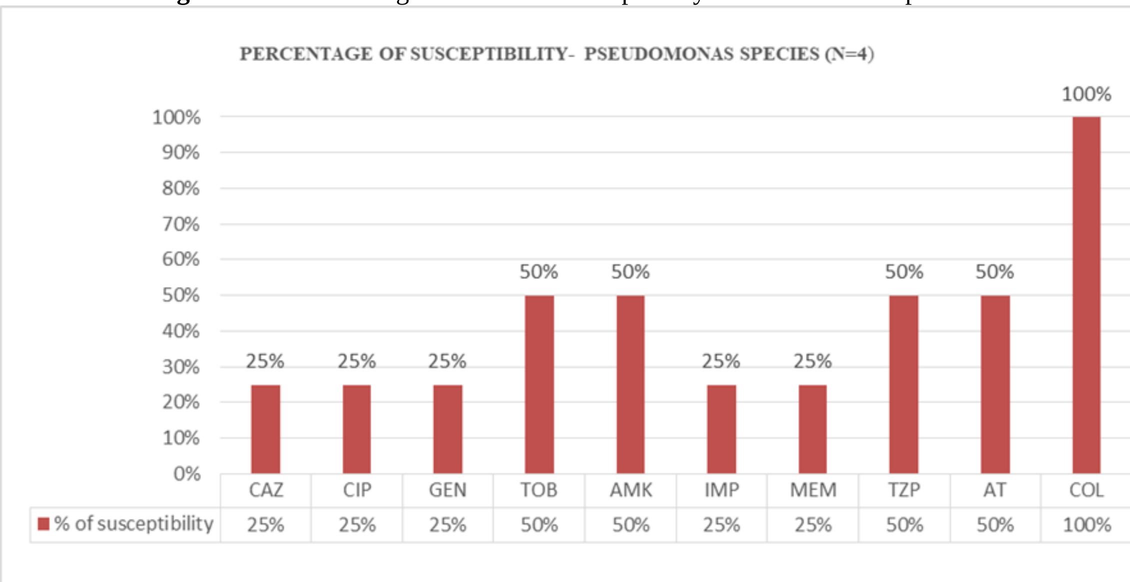

Figure no 3 shows the percentage of antibiotic susceptibility of Klebsiella pneumoniae.Klebsiella pneumoniae showed maximum sesnsitivity towards Colistin, and Amikacin. Highest resistance was towards Ciprofloxacin, Piperacillin/Tazobactum, Cefepime and Imipenem.

Figure no 3 : Percentage of antibiotic susceptibility of Klebsiella pneumoniae.

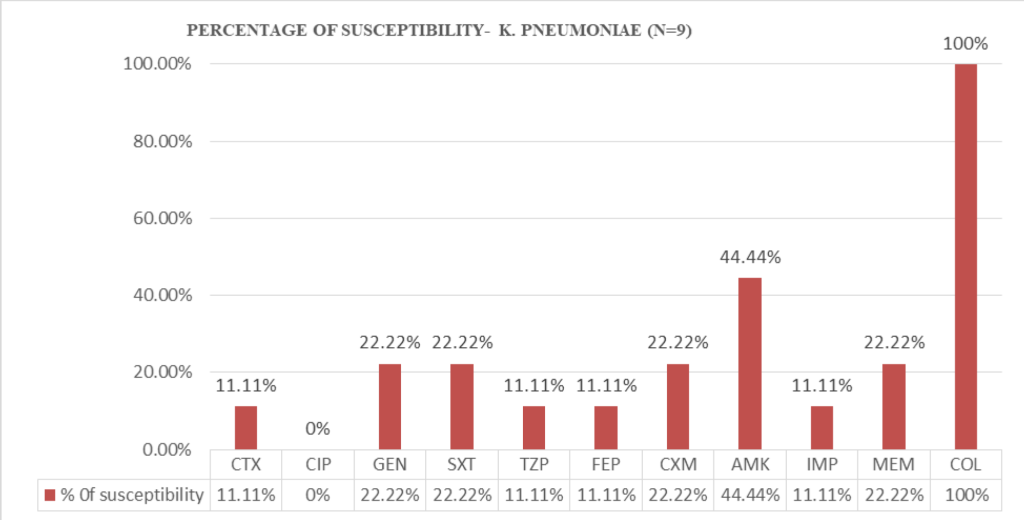

Figure no 4 shows the percentage of antibiotic susceptibility of Escherichia coli.

Escherichia coli showed maximum sensitivity towards Colistin, Gentamicin and Imipenem.Maximum resistance was towards Cefotaxim, Cefuroxime, Ampicillin and Ciprofloxacin.

Figure no 4 : Percentage of antibiotic susceptibility of Escherichia coli.

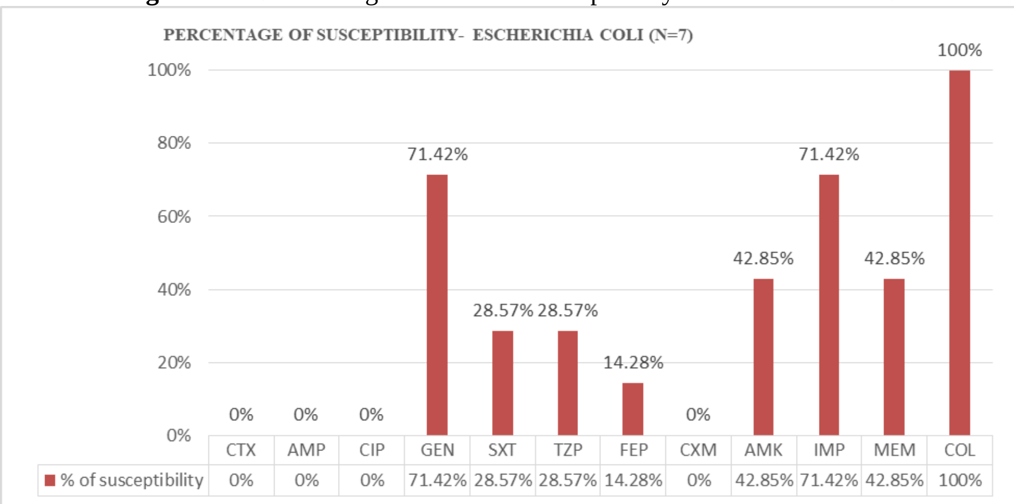

Figure no 5 shows the percentage of antibiotic susceptibility of Enterococcus species.

Enterococcus species were highest sensitive to Linezolid, Doxycycline and Vancomycin. Maximum resistance were towards Erythromycin and Penicillin.

Figure no 5 : Percentage of antibiotic susceptibility of Enterococcus species.

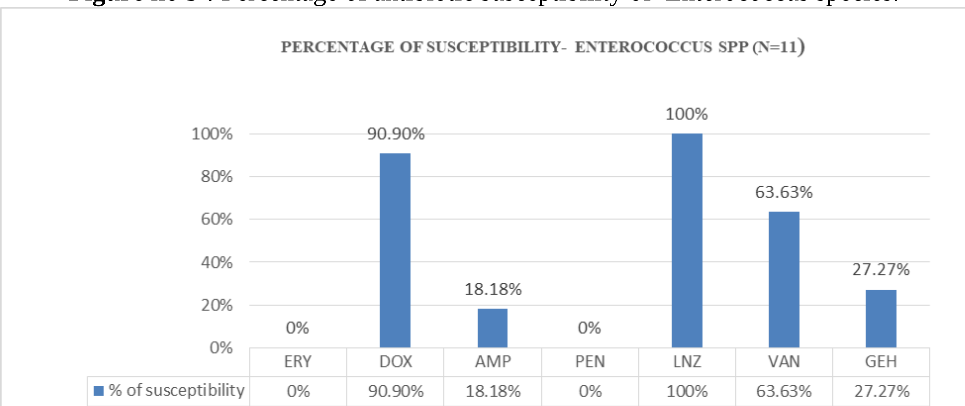

Figure no 6 shows the percentage of antibiotic susceptibility of Streptococcus species. Streptococcus species showed maximum sensitivity for Linezolid and maximum resistance for Erythromycin.

Figure no 6 : Percentage of antibiotic susceptibility of Streptococcus species

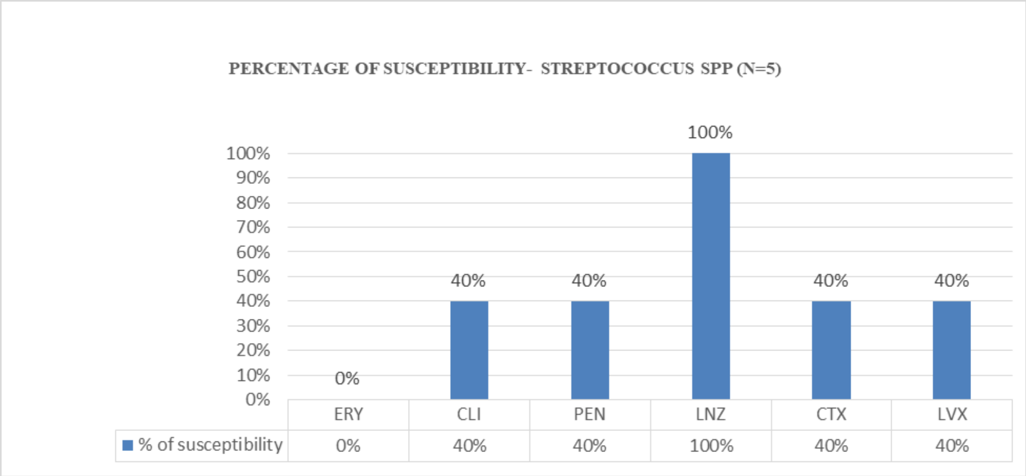

Figure no 7 shows the percentage of antibiotic susceptibility of Staphylococcus aureus. Staphylococcus aureus were highest sensitive to Linezolid and lowest sensitivity towards Erythromycin, Penicillin, Ciprofloxacin and Cotriamoxazole. Out of the 5 Staphylococcus species, 4 were Methicillin sensitive Staphylococcus aureus (MSSA) and 1 were Methicillin resistant staphylococcus aureus (MRSA).

Figure no 7 : Percentage of antibiotic susceptibility of Staphylococcus aureus.

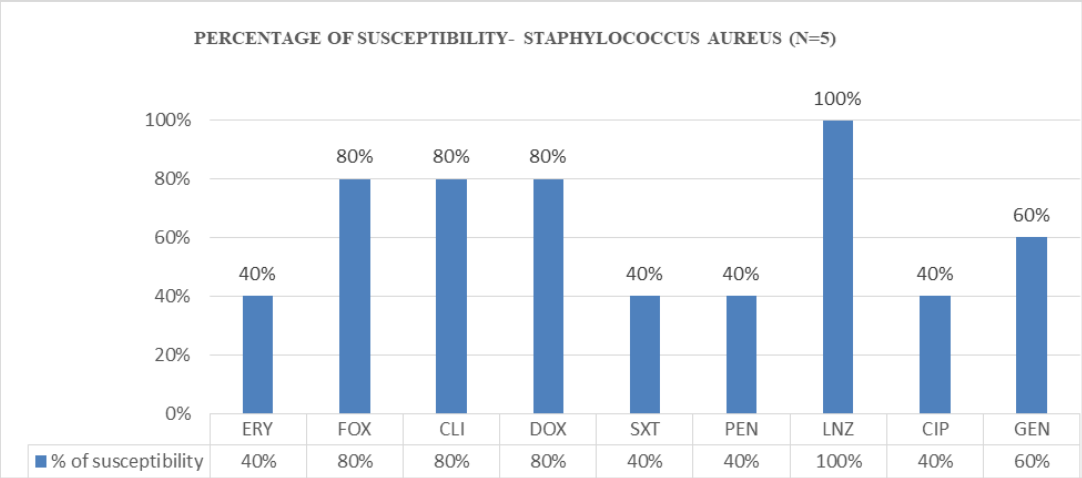

Table no2 shows Multidrug resistance pattern among isolated organisms. The highest number of Multidrug resistance was shown by Acinetobacter species followed by Escherichia coli. Out of 11 Enterococcus species, 4 Vancomycin resistant Enterococci were identified. Whereas 1 out of 5 Staphylcoccus aureus was Methicillin resistant, rest falling under Methicillin sensitive staphylococcus aureus.

Table no 2: Multidrug resistance pattern among isolated organisms

Organism	**Total Number**	**No Of Mdr Strains**
Acinetobacter Species	26	20 (76.92%)
Escherichia Coli	7	6 (85.71%)
Klebsiella Pneumoniae	9	5 (55.50%)
Vancomycin-Resistant Enterococcus (Vre)	11	4 (36.30%)
Pseudomonas Species	4	3 (75.71%)
Methicillin-Resistantstaphylococcus Aureus (Mrsa)	5	1 (25.00%)

IV. Discussion

As a medical emergency, bacterial meningitis requires prompt diagnosis and vigorous treatment [12].In developing nations, bacterial meningitis remains a significant source of illness and mortality even with the availability of efficacious medications [8, 12, 14]. It is empirically recommended, therefore, to begin antibiotic medication prior to the availability of all test findings. Understanding the most common etiological agents of meningitis present in the local population and their resistance pattern are necessary for such a blind treatment [3] .Out of the total 71 culture-positive samples, 38 (53.52%) were females and 33 (46.47%) were males. Infants 49 (69.01%) were more at risk than that of pediatric patients 22 (30.98%).50 (70.42%) of causative organisms were Gram-negative bacteria and 21 (29.57%) were Gram-positive bacteria.38 (53.52%) isolates were showing Multi-drug resistance, including 4 Vancomycin Resistant Enterococci (VRE) species. Acinetobacter spp. was identified as an emerging pathogen causing meningitis in the pediatric population with multidrug resistance. In a study conducted by Kasana D in 2020, similar findings were reported [1]

V. Conclusion

This study concludes that ampicillin-sulbactam, minocycline, tobramycin, and amikacin are the most effective medications against non-fermenter species.Contains imipenem, amikacin, and gentamicin to combat Enterobacteriaceae. Includes Clindamycin, Doxycycline, Vancomycin, and Linezolid when treating Gram-positive pathogens. With the emergence of multidrug-resistant organisms, the research area witnessed a change in the major cause of meningitis from Gram positive organisms to Gram negative organisms. The finding of Multidrug resistance bacterial isolates in CSF implies that infection control protocols, such as rigorous hand washing by medical personnel, equipment cleaning and disinfection, and mother prophylactic antibiotic use, should be closely adhered to in the research region. In order to detect modifications in the microbial profile and antibiogram of the pathogenic organism, such microbiological investigations ought to be carried out on a regular basis. It would support medical professionals in treating patients with acute bacterial meningitis more effectively and proactively.

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