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# Study of Bacterial Meningitis in Tertiary Care Hospital

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***Abstract****: Bacterial meningitis is life threatening and requires appropriate antibiotic therapy at the earliest possible moment.[2]Bacterial meningitis remains a significant cause of morbidity in this antibiotic era even in patients treated promptly and followed carefully. This study therefore undertaken to study Bacteriological profile and their antibiotic susceptibility pattern in Bacterial meningitis cases. Detection by clinical diagnosis supported with laboratory diagnosis (CSF analysis, Gram's stain, Culture) helps in timely intervention by the clinician to institute appropriate antibiotic therapy as early therapy is imperative in reducing morbidity and mortality[5]. This study therefore undertaken to aid in diagnosis of acute bacterial meningitis cases by Gram's stain and Culture of CSF in cases of acute bacterial meningitis and to study the antibiotic susceptibility pattern of isolates.*

***MATERIALS AND METHODS****:This prospective study was done in the Department of Microbiology, Guntur Medical College and Government General Hospital, Guntur for the period of one year.A total of 100 clinically suspected cases of meningitis aged from 1 day to 75 years admitted in Government General Hospital, Guntur constituted the study group.Cerebrospinal fluid (CSF) samples collected from pediatric, medical and neuromedical and emergency wards of Government General Hospital, a tertiary care hospital. They are tested for both conventional microscopy, bacterial culture and sensitivity tests.*

***Results****: In the present study of 100 suspected cases of meningitis, 38 cases (38%) were positive by Gram stain, Culture.Culture positive in 24 cases (63.15%) males and 40(40%) were females, making a ratio of 1.5:1. Out of 38 positive cases, 14 (36.84%) were S pneumonia, 14 (36.84%) were N meningitidis. 4 (10.52%) were S aureus, 4 (10.52%) were Escherichia coli, 2 (5.26%) were Group B streptococci. (Table-VI). Culture is a gold standard technique but it takes 24-48 hours for reporting. Gram's stain detects most of the cases immediately and suggests prompt treatment of bacterial meningitis at early stages to prevent deaths and complications, disability (morbidity and mortality). Meningococci and pneumococci are still the important causes of bacterial meningitis in both children and adults.*

***Key Words*** *:Bacterial meningitis,Gram stain,Culture,Antibiogram*

**Aims and Objectives of the Study**

1. To know the etiological agents and their antibiotic susceptibility pattern of pathogen isolated in bacterial meningitis.
2. For early detection and treatment of Bacterial meningitis cases to prevent complications.

## I. Introduction

Bacterial meningitis is life threatening and requires appropriate antibiotic therapy at the earliest possible moment.[2] Bacterial organisms are usually the cause of purulent infections.There is an urgent need for the laboratory diagnosis of suspected meningitis.Organisms may gain access to the CNS through several primary routes. Hematogenous spread is the most common route of infection for the CNS followed by direct spread from an infected site e.g., otitis media, sinusitis, mastoiditis. Anatomic defects in CNS structures as a result of surgery, trauma, or congenital abnormalities also can allow microorganisms easy and ready access to the CNS.[1]

The host's age and other underlying factors contribute to predisposition of infectious meningitis. Neonates have the highest infection rate for meningitis because of the immature neonatal immune system, the increased permeability of the blood-brain barrier (BBB) in newborns, and the presence of Most cases occur in children younger than 5 years of age. Neonates have the highest incidence of acute meningitis with a concomitant increased mortality rate (as high as 20%). The percentage of adults with nosocomial bacterial meningitis at large urban hospitals has been increasing. [1]

In elderly, debilitated or immunosuppressed patients unexpected alteration in mental status may be the only clue. Various degrees of confusion, agitation , disorientation or coma may be observedcolonizing bacteria in the female genital tract that can pass to the infant during childbirth.Bacterial meningitis remains a significant cause of morbidity in this antibiotic era even in patients treated promptly and followed carefully.

This study therefore undertaken to aid in rapid diagnosis of acute bacterial meningitis cases by Gram's stain and Culture evaluation of Grams's stain and culture in cases of acute bacterial meningitis and to study the antibiotic susceptibility pattern of isolates.

This study therefore undertaken to aid in diagnosis of acute bacterial meningitis cases by Gram's stain and culture in CSF in cases of acute bacterial meningitis and to study the antibiotic susceptibility pattern of isolates.

## II. Materials And Methods

This prospective study was done in the Department of Microbiology, Guntur Medical College and Government General Hospital, Guntur for the period of one year.

A total of 100 clinically suspected cases of meningitis aged from first day to seventy five years admitted in Government General Hospital, Guntur constituted the study group.

Blood and Cerebrospinal fluid (CSF) samples collected from pediatric, medical and neuromedical and emergency wards of Government General Hospital, a tertiary care hospital.

They are tested for conventional microscopy, bacterial culture and sensitivity tests.

**Inclusion Criteria**:

Children and adults admitted to Government General Hospital with history of fever with chills, rigors and neck rigidity and vomiting, drowsiness and altered sensorium were included in the study.
All cases with or without antibiotic usuage included.

**Exclusion Criteria**:

All cases of meningitis secondary to trauma and iatrogenic excluded.

**Specimen Collection**:

CSF samples were collected by Pediatricians in NICU, PICU and emergency wards, physicians in AMCU, Medical, Neuro medical and emergency wards on immediate arrival of the case with clinical suspicion of meningitis. CSF was collected by lumbar puncture done with all aseptic precautions. Informed consent was taken from the parents of patients for performing lumbar puncture.

**Procedure:** A sterile 22 gauge needle was introduced into the subarachnoid space between L3 and L4 vertebrae and 2cc of CSF was collected drop by drop into a sterile screw capped container.

**Transport:** Samples were taken to the laboratory immediately and processed without delay on arrival.
The CSF was divided into 3 portions.

- One portion was taken into a sterile test tube and centrifuged at 3000 rpm for 20 minutes.. The sediment was used for preparing Gram stained smears.
- The second portion was used for inoculating on blood agar, chocolate agar and MacConkey agar plates.

Third portion was used for adding to BHI broth.Antibiotic susceptibility testing was done by standard Kirby-Bauer disc diffusion method and controls were put up according to NCCLS guidelines.

| Gram positive organisms | Gram negative organisms |
|---|---|
| **Discs Used** | **Discs Used** |
| 1. Bacitracin 10µg | 1.Ampicillin/Sulbactam 10/10µ |
| 2. Azithromycin 15µg | 2.Amikacin 30µg |
| 3. Ampicillin/Sulbactam 10/10µg | 3.Gentamycin 30µg |
| 4. Gentamycin 30µg | 4.Ciprofloxacin 5µg |
| 5. Ciprofloxacin 5µg | 5. Ceftriaxone 30µg |
| 6. Ceftriaxone 30µg | 6.Piperacillin 100µg |
| 7. Vancomycin 30µg | 7. Azithromycin 15µg |
| 8. Piperacilin 100µg | |
| 9. Amikacin 30µg | |

## III. Results

The present study was carried out in the Department of Microbiology, Guntur Medical college, Guntur for a period of one year from February 2013 to January 2014.

100 cases of suspected meningitis aged from 1 day to 75 years who were admitted into NICU, PICU of Paediatric department, Medical and Neuromedicine wards of Government General Hospital, Guntur were investigated for laboratory diagnosis of meningitis by collecting CSFsamples .

Gram stain, culture and sensitivity tests, carried out for the above 100 samples of CSF .

In the present study of 100 suspected cases of meningitis, 38 cases (38%) were positive by Gram stain, CultureIn the present study of the 100 suspected cases, 60 (60%) were males and 40(40%) were females, making a ratio of 1.5:1.

Results show that out of 100 cases, 38 cases(38%) positive for bacterial meningitis. The male and female ratio for positive cases was 1.375:1 (males 22, 57.89%) (females16, 42.1%)

In the neonatal age group, out of 8 cases 4 (10.5%) were positive.

In infant age group, out of 12 cases, 6(15.78%) cases were positive.

In children age group (2-15yr), out of 26 cases, 12 (31.57%) were positive.

In the adult age group (16-55yr), out of 52 cases, 16 cases (42.1%) were positive. In elderly group, out of 2 cases, no case is positive. (Table-II).

In the present study, 91% of cases present with fever, headache and convulsions, of which 29 cases (31.8%) are positive. 54 cases presented with altered sensorium and drowsy, out of which 26 cases (48.14%) were positive. 46 cases presented with refusal of feeds, of which 16 cases (34.7%) were positive. Neck stiffness is seen in 61 cases, of which 31 cases (50.8%) were positive. Complications are seen in 9 cases with recurrent meningitis, of which 7 cases (77.7%) were positive. (Table-III).

Neonatal age group presented with 4 cases (10.52%). Children age group (2m-15yr) presented with 18 cases (47.36%). Adult age group (16-55yr) presented with 16 cases (42.10%). Meningococci (8 cases),(21.05%) were predominantly seen in the children age group. Pneumococci were predominantly seen in the adult age group (10 cases), (26.31%).Group B Streptococci were seen in the infant age group (2 cases, 5.26%). E coli (4cases, 10.52%) were seen in the neonatal age group.Staphylococcus aureus seen in the (4 cases, 10.52%) infant age group. (Table-IV)Out of 38 positive cases, Direct Gram stain positive in 24 cases (63.15%), .Culture positive in 24 cases (63.15%)Out of 38 positive cases, 14 (36.84%) were S pneumonia, 14 (36.84%) were N meningitidis. 4 (10.52%) were S aureus, 4 (10.52%) were Escherichia coli, 2 (5.26%) were Group B streptococci. (Table-VI).In Direct smear examination of CSF, out of 24 (63.15%) Gram stain positive cases,14 (58.33%) were Streptococcus pneumonia , 6 were Neisseria me ningitidis (25%). Other organisms like Staphylococcus aureus seen in 4 cases (16.66%), Escherichia coli and Group B streptococci reported nil.(Table-VII)

Out of 24(63.15%) Culture positivecases, 14 (58.33%) were S pneumonia, 6 (25%) were N meningitidis. 4 (16.6%) were S aureus. Escherichia coli and Group B streptococci reported nil. (Table-VIII).In both Gram stain and Culture, 14(36.84%) cases of pneumococci were isolated,Staphylococcus aureus(4 cases, 10.52%) was positive in Gram stain and Culture,From the comparative analysis, it is seen that sensitivity and specificity for Gram stain and Culture was 83% and 100%.Antibiogram: Antibiotic susceptibility testing was done on all the 24 culture positive isolates, Streptococcus pneumoniae (14 cases, 36.84%), N meningitidis (6, cases, 15.78%), and Staphylococcus aureus (4 cases, 10.52%).

S. pneumonia all (14 cases,100%) were sensitive to Ciprofloxacin, Ceftriaxone, and Bacitracin. 10 cases (71.4%) were sensitive to Ampicillin/Sulbactam and gentamycin. 7 cases (50%) were sensitive to Azithromycin and Piperacillin. Amikacin sensitive seen in 4 cases(28.6%).

Meningococci, all 6 cases (100%) were sensitive to Ceftriaxone. 3 cases (50%) were sensitive to Azithromycin, Ampicillin/Sulbactam, Gentamycin, Ciprofloxacin, Amikacin and Piperacillin.

S. aureus all 4 cases (100%) were sensitive to Ciprofloxacin and Vancomycin. 3 cases (75%) were sensitive to Ceftriaxone. 2 cases(50%) were sensitive to Azithromycin,Ampicillin/Sulbactam, Gentamycin, Amikacin and Piperacillin. (Table-XIII).

**TABLE-I**

**Prevalence of Bacterial meningitis cases:**

| Total no. of cases | Positives | Percentage(%) |
|---|---|---|
| 100 | 38 | 38% |

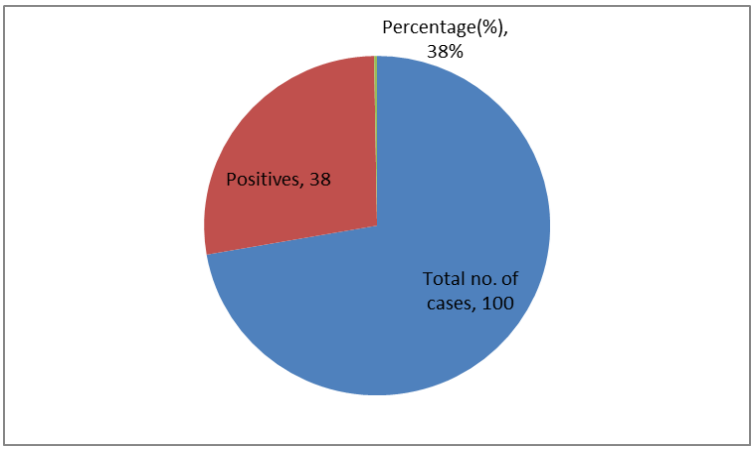


**TABLE-II**
**Age and Sex- wise distribution of Cases:**

| Age | Total no.of cases | Male | Positive cases (%) | Female | Positive cases (%) |
|---|---|---|---|---|---|
| 0-1 month | 8 | 4 | 2(5.26%) | 4 | 2(5.26%) |
| 2 month to 1 yr | 12 | 4 | 2(5.26%) | 8 | 4(10.5%) |
| 2 yr – 15 yr | 26 | 16 | 8(21.05%) | 10 | 4(10.5%) |
| 16 yr – 35 yr | 36 | 20 | 8(21.05%) | 16 | 4(10.5%) |
| 36 – 55 yr | 16 | 14 | 2(5.26%) | 2 | 2(5.26%) |
| 56 -75 yr | 2 | 2 | 0 | 0 | 0 |
| Total | 100 | 60 | 22(57.89%) | 40 | 16(42.1%) |

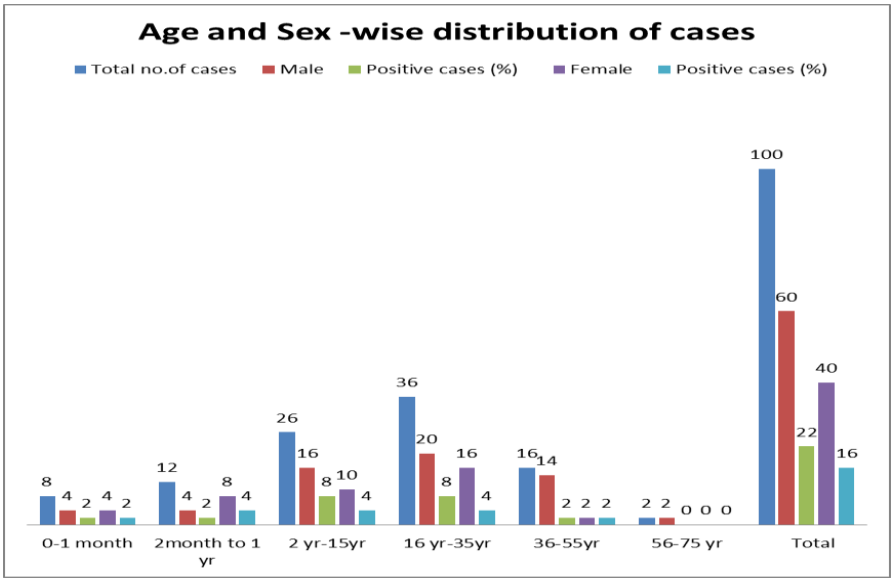



**TABLE-III**
**Clinical presentation of the study group**

| Symptoms and signs | No.of cases | Positive cases | Percentage(%) |
|---|---|---|---|
| Fever, headache,convulsions | 91 | 29 | 31.8% |
| Altered sensorium, irritability and drowsy | 54 | 26 | 48.14% |
| Refusal of feeds | 46 | 16 | 34.7% |
| Neck stiffness | 61 | 31 | 50.8% |
| Complications like hydrocephalus,epilepsy, cranial nerve palsies, deafness | 9 | 7 | 77.7% |

**Clinical presentation of the study group**

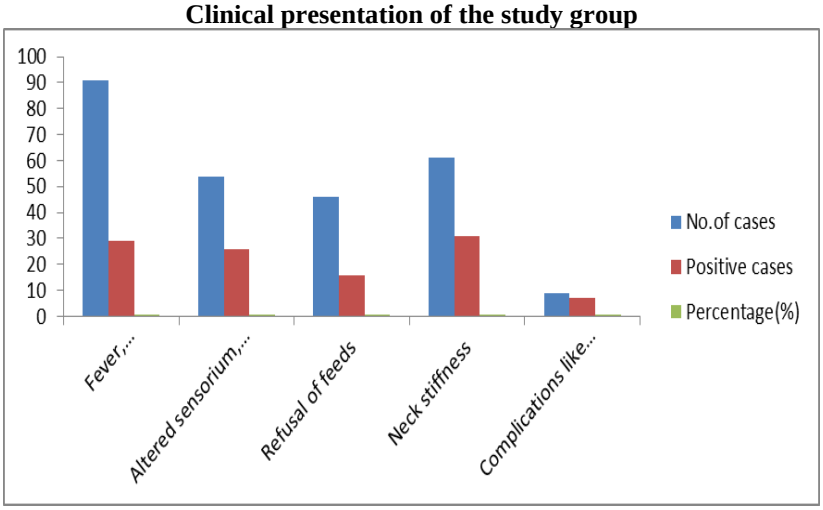


**TABLE-IV**
**Age-wise distribution of organisms**

| Age | Organism | Total no. of cases | Percentage |
|---|---|---|---|
| 0-1m | E coli-4 | 4 | 10.52% |
| 2m-1yr | S aureus-4,<br>Group B streptococci-2 | 6 | 15.78% |
| 2yr-15yr | Pneumococci-4,<br>Meningococci-8 | 12 | 31.57% |
| 16yr-35yr | Meningococci-4,<br>Pneumococci-8, | 12 | 31.57% |
| 36yr-55yr | Meningococci-2,<br>Pneumococci-2 | 4 | 10.52% |
| 56yr-75yr | - | - | - |
| Total | | 38 | 100% |

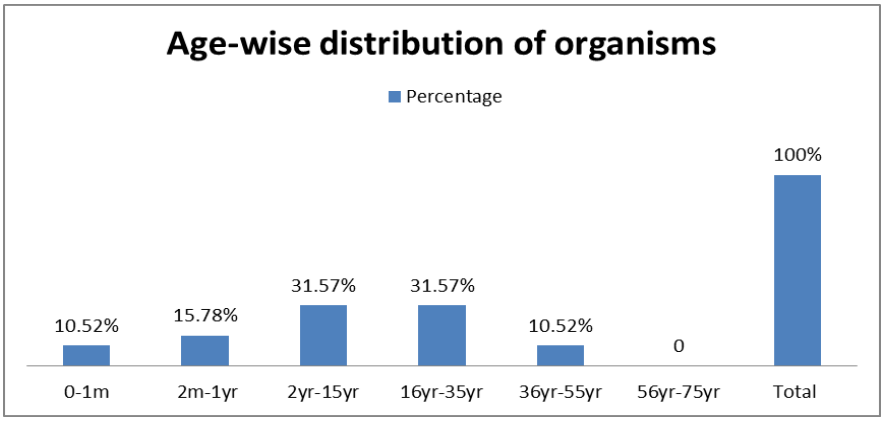



**TABLE-VI**
**Total number of organisms identified in the present study**

| Organisms | No. detected | Percentage (%) |
|---|---|---|
| S pneumonia | 14 | 36.84% |
| N meningitidis | 14 | 36.84% |
| S aureus | 4 | 10.52% |
| Escherichia coli | 4 | 10.52% |
| Group B streptococci | 2 | 5.26% |
| | 38 | 100% |

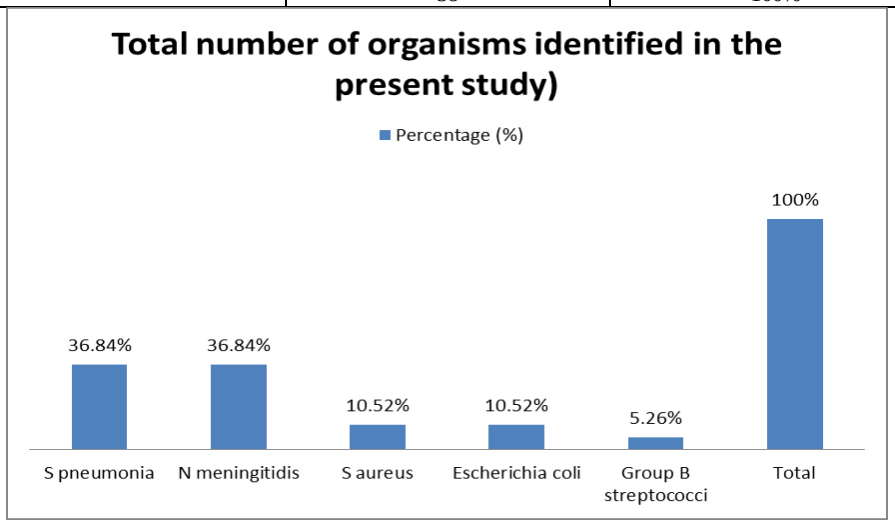



**TABLE-VII**
**Organisms detected by Direct Gram stain**

| Organisms seen in Direct Gram stain | Total no. of organisms seen | Percentage(%) |
|---|---|---|
| S pneumonia | 14 | 58.33% |
| N meningitidis | 6 | 25% |
| Staphylococcus aureus | 4 | 16.66% |

| | | |
|---|---|---|
| Escherichia coli | - | - |
| Group B streptococci | - | - |
| Total Gram stain Positive cases | 24 | 100% |

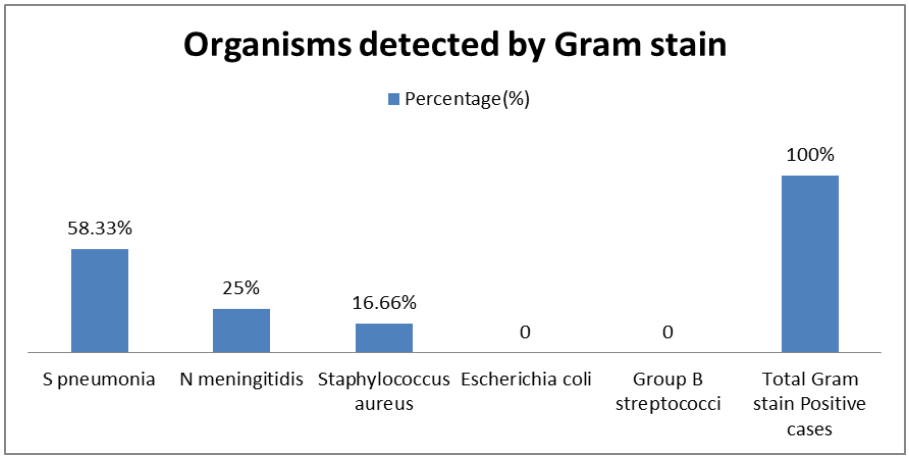



**TABLE-VIII**
**Organisms isolated by Culture**

| Organisms isolated in culture | Positive | Percentage (%) |
|---|---|---|
| S pneumonia | 14 | 58.33% |
| N meningitidis | 6 | 25% |
| Group B streptococcus | - | - |
| Escherichia coli | - | - |
| S aureus | 4 | 16.6% |
| | 24 | 100% |

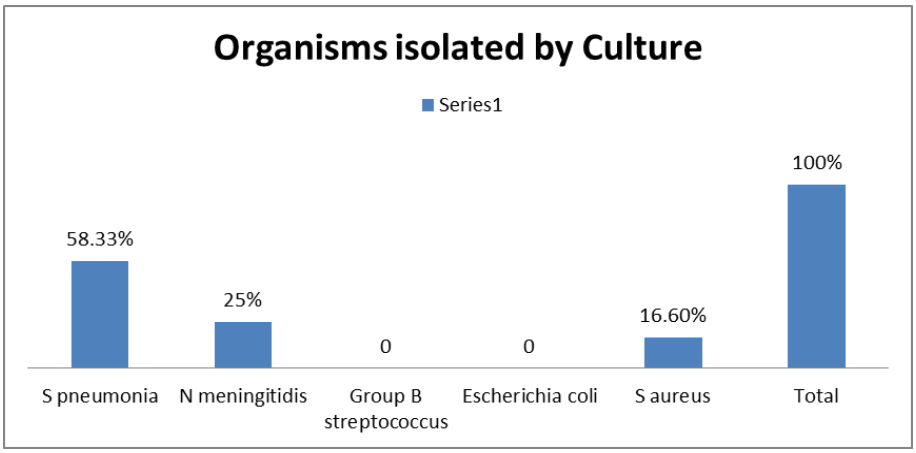
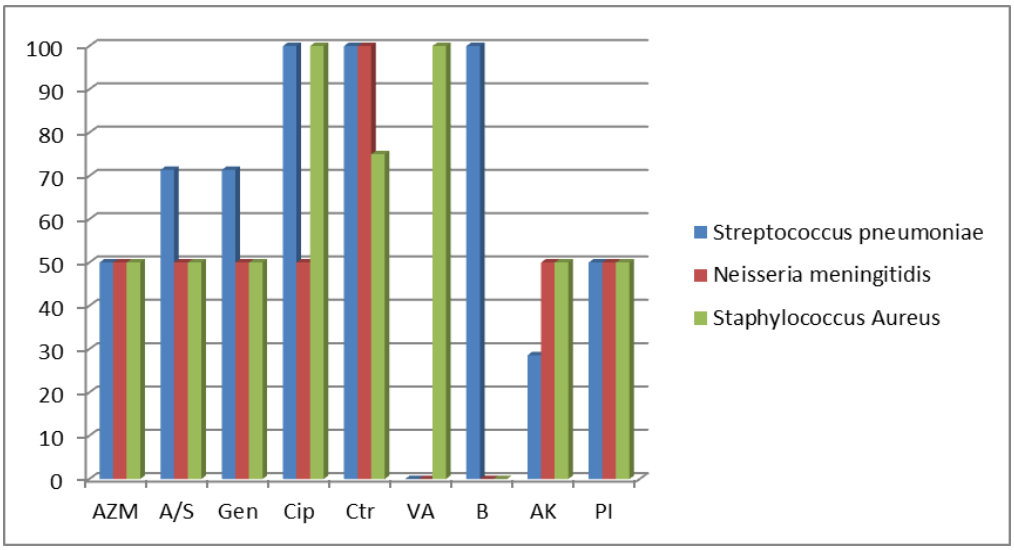
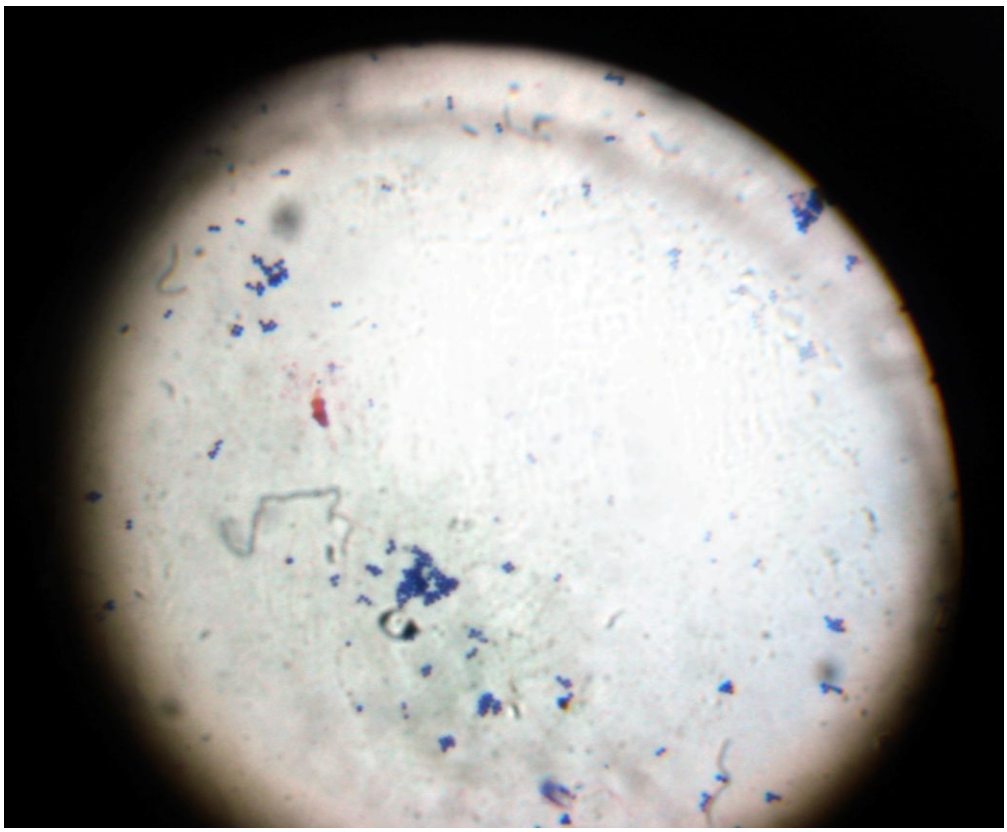



**TABLE-IX**
**Percentage of sensitivity of the organism to the antibiotics.**

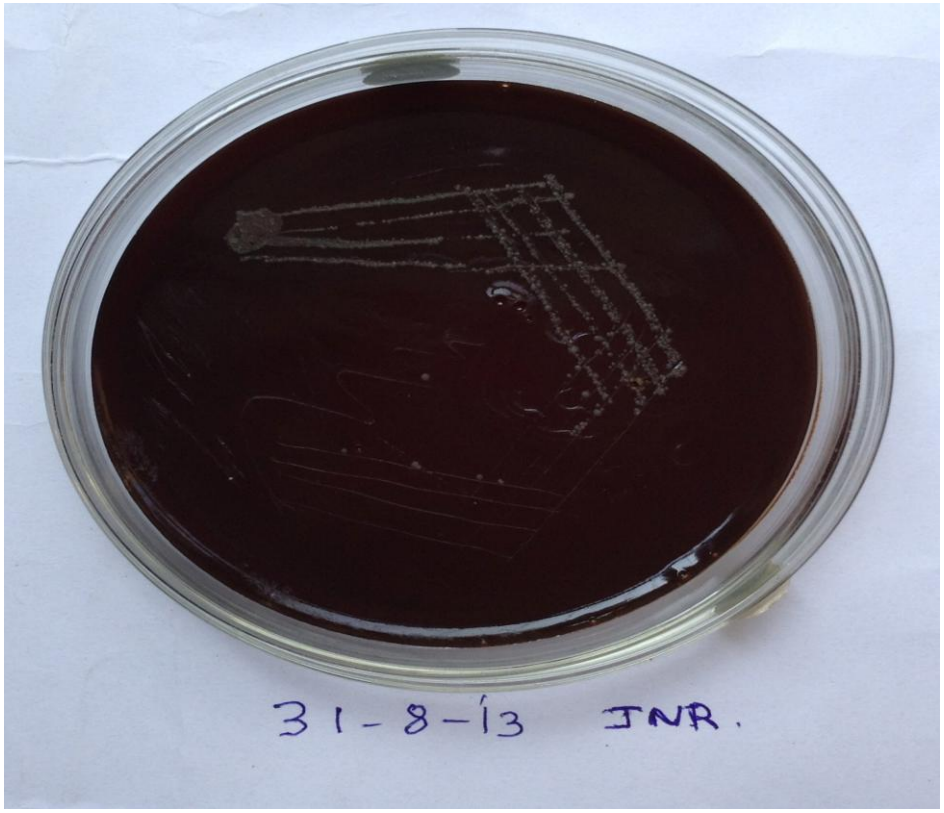
| Organism | No. tested | AZM | A/S | Gen | Cip | Ctr | VA | B | AK | PI |
|---|---|---|---|---|---|---|---|---|---|---|
| Strepto-coccus pneumoniae | 14 | 7S (50%) | 10 S (71.4 %) | 10 S (71.4%) | 14S (100%) | 14S (100%) | - | 14 S (100%) | 4S (28.6% ) | 7S (50%) |
| Neisseria meningitidis | 6 | 3S (50%) | 3S (50%) | 3 S (50%) | 3S (50%) | 6S (100%) | - | - | 3S (50%) | 3S (50%) |
| Staphylo-coccus Aureus | 4 | 2S (50%) | 2S (50%) | 2S (50%) | 4S (100%) | 3S (75%) | 4S (100% ) | - | 2S (50%) | 2S (50%) |

AZM=Azythromycin, A/S=Ampicillin/Sulbactam, Gen=Gentamycin, Cip=ciprofloxacin,Ctr=ceftriaxone,VA= Vancomycin,B=Bacitracin, AK=Amikacin,PI=Piperacillin

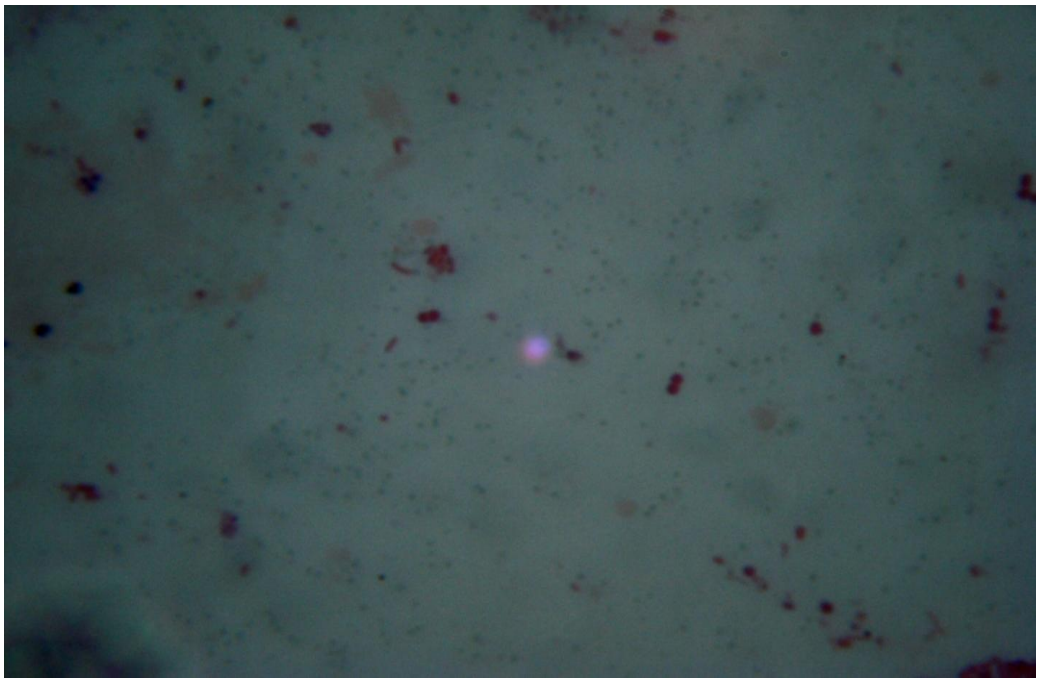


**Streptococcus pneumoniae - Gram's Stain**



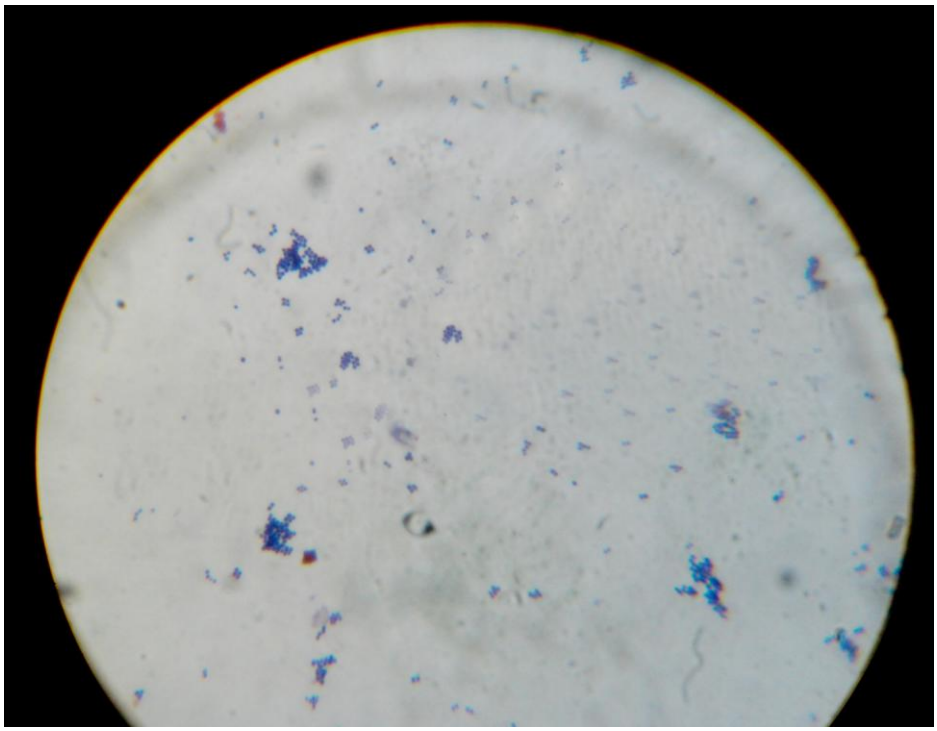

**Streptococcus pneumonia growth on Chocolate Agar**



**Neisseria meningitides- Gram's Stain**

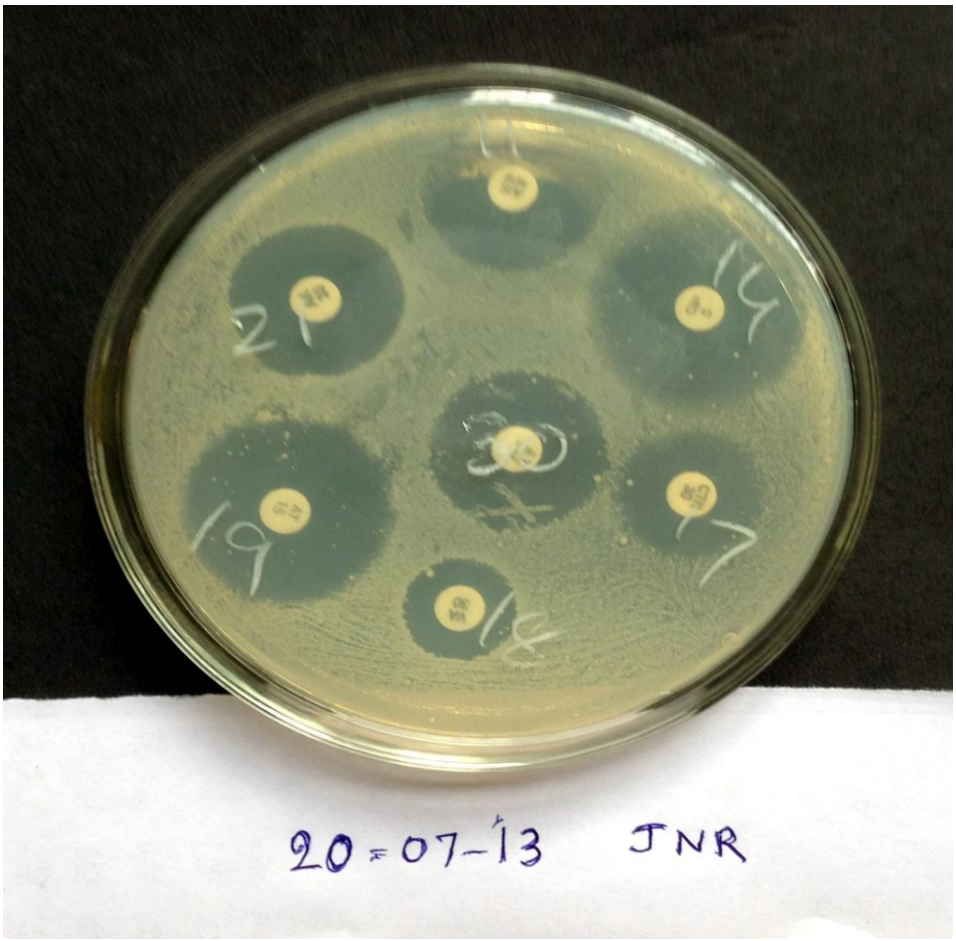
**Meningococci Growth on Chocloateagar**


**Meningococci- Antibiotic susceptibility test**
**Azm= Azithromycin; A/S= Ampicillin/Sulbactam; Cip= Ciprofloxacin; Ctr= Ceftriaxone; Ak= Amikacin; PI= Piperacillin**

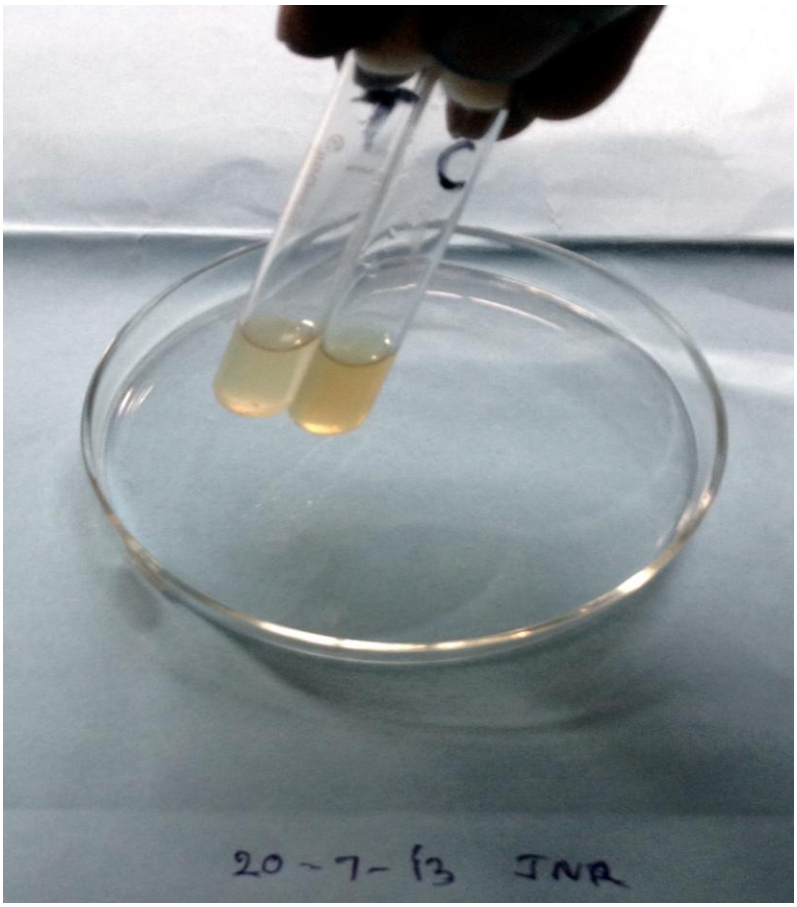


**Staphylococcus aureus- Gram's Stain**


**Staphylococcus aureus growth on Nutrient Agar**




**Staphylococcus aureus- Antibiotic Susceptibility Test**
**A/S= Ampicillin/Sulbactam; Cip= Ciprofloxacin; Ctr= Ceftriaxone; VA= Vancomycin; Azm= Azithromycin; Ak= Amikacin; PI= Piperacillin**




**Tube Coagulase test- Staphylococcus aureus**


**Control Test Brain Heart Infusion broth**

## IV. Discussion

The present study was taken up in the Department of Microbiology, Guntur Medical College, Guntur for a period of one year .

100 cases of suspected meningitis aged from 1 day to 75 years who were admitted into NICU, PICU of Paediatric department, Medical and Neuromedicine wards of Government General Hospital, Guntur were investigated for laboratory diagnosis of meningitis by collectioning CSF samples, Gram stain, Culture and sensitivity tests carried out for the above 100 samples of CSF and Blood.

In the present study, as per WHO criteria of a proven case of bacterial meningitis, 38 cases (38%) out of 100 suspected cases of bacterial meningitis were laboratory confirmed as bacterial meningitis. The male and female ratio in our study is 1.37:1The present study showed 57.89% incidence of bacterial meningitis in children

Bacterial meningitis is essentially a disease of young children due to attenuated immune response. Poor socio-economic conditions, overcrowding, recent colonization with pathogenic bacteria, close contact with patients, splenic dysfunction, cerebrospinal fluid communications (congenital or acquired) across the mucocutaneous barrier are some of the host factors which increase the risk of meningitis.

The present study showed the Direct Gram-stain positive percentage of 63.15% The Gram stain is rapid and less expensive, but the detection of microorganisms depends on number of organisms present, prior use of antibiotics, staining technique and observer's skill. Although culture is considered to be the definitive diagnostic test, microscopic examination of Gram-stained specimen of cerebrospinal fluid may provide immediate information about the causative microorganism. Streptocccuspneumoniae was the commonest agent in children. Since identification of organism is very important to institute appropriate antibioticsCSF culture is a definitive diagnostic test and gold standard test and requires 24-48 hours for reporting.

Culture is time consuming and can give false-negative results if the specimen has been transported and stored under unsatisfactory conditions or if an antibiotic therapy has been initiated before the specimen was taken. Several studies report poor CSF culture positivity under Indian condition In the present study, the organisms are 100% sensitive to gentamycin, Ceftriaxone .Third generation and fourth generation cephalosporins (Cefotaxime, Ceftriaxone, Cefepime.Cefoperazone) along with aminoglycosides (gentamycin, Amikacin Kanamycin) are effective in treatment of adult cases. Penicillin and penicillin group of drugs (Ampicillin, Amoxicillin) are still

effective drugs in both children and adults with bacterial meningitis. They can be used as both empirical treatment and effective management of bacterial meningitis cases

Other commonly used antibiotic may still have role in treating bacterial meningitis, organisms were 100% sensitive to Vancomycinand Ciprofloxacin .

## V. Conclusions

Bacterial meningitis is an important serious illness world-wide and is a medical emergency. It still remains major cause of death and long term neurological disabilities. Prompt diagnosis and aggressive management are the goals for which we need laboratory diagnosis as early signs and symptoms are often non-specific. Culture is a gold standard technique but it takes 24-48 hours for reporting. Gram's stain detects most of the cases immediatelyprompt treatment of bacterial meningitis at early stages to prevent deaths and complications, disability (morbidity and mortality).

Meningococci and pneumococci are still the important causes of bacterial meningitis in both children and adults. The study of bacterial meningitis is important as it reflects the diagnostic abilities of various tests available to detect early and also antibiotic susceptibility pattern of the causative organisms in a particular area to prevent deaths and complications. Vaccine preventable organisms causing bacterial meningitis can be tried in immunization schedules in India particularly in children because it is cost-effective. Penicillin and penicillin group of drugs are still effective drugs in both children and adults with bacterial meningitis and can be used as both empirical treatment and effective management.

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