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ORIGINAL ARTICLE

Incidence and Causative Organisms of Acute Bacterial Meningitis, our Hospital Experience

SYED AAMIR SHAH[1], FAHMIDA ARAB MALLAH[2], ABDUL RAZAQUE MARI[3], KHADIJA TAHIRA[4], MADEHA AMJAD[5], ANUM KHAN[6]
[1]*Assistant Professor Neurosurgery, Pakistan Institute of Medical Sciences Islamabad, Pakistan*
[2]*Assistant Professor Neurosurgery, People's university of Medical and health sciences for women Nawabshah, Pakistan*
[3]*Associate professor Neurosurgery, People's University of Medical and Health Sciences for women Nawabshah Pakistan*
[4,5,6]*Postgraduate Resident of Neurosurgery, Pakistan Institute of Medical Sciences Islamabad, Pakistan*
Corresponding author: Syed Aamir Shah: Email: dr_aamir_shah@hotmail.com

ABSTRACT
Aim: To determine the incidence and causative organism of acute bacterial meningitis in patients presented with suspected meningitis
Study Design: Cross sectional study
Place and duration: This study was conducted in Pakistan Institute of Medical Sciences Islamabad, Pakistan from April 2019 to March 2020.
Methodology: A total of 350 patients with suspected meningitis were included in the study. Lumbar puncture is used to obtain samples of the cerebrospinal fluid (CSF). CSF analysis, CSF microbiological inspection, blood culture, and antibiotic sensitivity testing were all performed. In certain individuals, magnetic resonance imaging (MRI) of the brain was conducted prior to lumbar puncture. All patients with acute bacterial meningitis (ABM) had their epidemiologic characteristics, clinical data, and laboratory findings analyzed in detail, as well as the causative organisms and prognosis.
Results: Meningitis was found in people of all ages. A considerable number of meningitis patients (60 percent) indicated a positive history of antibiotic use in the days leading up to hospital admission. CSF leukocyte counts in the range of > 100 to 1,000 cell/mm3 were found in 79.1% of ABM patients, while CSF neutrophil percentages were found in 80%. In 86.4 percent of patients, microorganisms were discovered on a direct Gram-stained smear. Gram-positive bacteria were found in 55 of 110 cases (50 percent). Gram-negative bacteria were found in 40 of the 110 cases (36.4 percent). ABM had a high risk of death (22.7 percent). ABM had a mortality rate of 22.7 percent.
Conclusions: Meningitis is an endemic disease in our region, with a high fatality rate. Acute bacterial meningitis is very common in patients presenting with suspected meningitis. The most prevalent pathogen was Streptococcus pneumoniae.

INTRODUCTION
Meningitis is a serious health problem caused by a variety of pathogenic organisms that vary in age and spread. The infection could spread through the bloodstream or through the ears, nasopharynx, cranial injury, or congenital meningeal abnormality[1]. Due to acute meningeal inflammation, bacterial meningitis is associated with considerable morbidity and mortality. More than one million individuals are infected each year around the world, and it is more prevalent in developing nations such as Africa's meningitis belt. This belt runs from Senegal to Ethiopia, and it is here that the illness load is highest.

In 26 nations, more than 400 million individuals are at risk of infection. Escherichia coli, Neisseria meningitidis, Streptococcus pneumoniae, Haemophilus influenzae, Streptococcus Group B, Staphylococcus aureus, and Listeria monocytogenes have all been linked to the outbreak. Human herpes virus 6, herpes simplex virus (HSV), varicella zoster virus (VZV), cytomegalovirus (CMV), Epstein-Barr virus, JC virus, and enterovirus are among the viruses that cause infections. Malignant cells, medications, and blood following a subarachnoid hemorrhage are non-infectious etiologies. Despite the fact that viral meningitis is more common, bacterial meningitis is more dangerous. Bacterial meningitis affects 40 out of every 100,000 people in poor countries. When the CSF is normal, the clinical picture may include definite meningitis, encephalitis, or meningismus[2]. In Egypt, bacterial meningitis is common, with Streptococcus pneumoniae being the most common cause (42 percent)[3,4]. Epilepsy, hearing loss, hydrocephalus, and cognitive impairments are among the long-term effects of the condition. In both developing and developed countries, significant morbidity and death occur, with mortality rates as high as 5% and long-term morbidity as high as 15%[5].

The present study is planned to determine the incidence and causative organism of acute bacterial meningitis in patients presented with suspected meningitis

METHODOLOGY
This study was conducted in Pakistan Institute of Medical Sciences Islamabad, Pakistan from April 2019 to March 2020. All patients gave their informed consent, and the study protocol was approved by the Zagazig University Faculty of Medicine's ethical council. Total 350 patients with suspected meningitis included for the study. Patients with fever, meningeal symptoms, impaired mental status, and an abnormal quantity of white blood cells in their CSF were diagnosed as bacterial meningitis. Patients with symptoms suggestive of meningitis, no identifiable cause (bacterial infection, fungal infection, autoimmune illness, injury, malignancy, or medications), and complete recovery with only conservative therapy were thought to have viral meningitis[6].

Inclusion and exclusion criteria were used to recruit patients. Inclusion criteria: a) In adults, Sudden onset of fever with neck stiffness, altered level of consciousness, or purpura fulminans; b) any child less than 2 years of age with acute fever and one of the following symptoms: neck stiffness, or flaccid neck, bulging fontanel, convulsion, or purpura fulminans. Cases admitted with suspected meningitis as a result of a head injury, a neurosurgical surgery, or a brain abscess were excluded[7]. All of the patients were given a medical history and a physical examination.

A sterile spinal needle (25 or 27 G) was used to collect CSF from the subarachnoid space between the fourth and fifth lumbar vertebrae. Two sterile, screw-capped tubes were used to collect the CSF. Each tube held two milliliters of CSF. No 1 (for direct Gram' stain, standard bacteriological culture procedures, and antibiotic sensitivity testing) was the first tube. No 2 (for physical (colour, aspect), chemical (glucose level, protein concentration), and cytological investigation) was the second tube. Blood was collected from patients using a stringent aseptic approach. An ethanol swab was used to wipe the top of the culture vial, and 10-12 ml of blood was obtained.

The first specimen of CSF was centrifuged for 20 minutes at 2000-3000 rpm. The sediment was agitated to resuspend the supernatant, which was aspirated with a sterile pipette, leaving approximately 0.5ml of fluid in the specimen tube (supernatant was kept for biochemical tests).

CSF' was analyzed for physical properties: colour and aspect, Cytological examination: Leukocytes were rated as negative (less than 10), 1+ (10–50), 2+ (51–290), and 3+ (more than 291 cells/uL). Microbiological examination: Microbiological standards were followed while preparing direct smears stained with Gram. Gram-stained smears were examined under the microscope, CSF's Culture: Blood, chocolate, and Mac-agar Conkey's plates were inoculated, and the plates were then incubated aerobically and anaerobically at 37°C for 72 hours in the presence of 5-10 percent CO_2. Bacterial colonies are identified by colony shape and biochemical responses.

The sensitivity of the recovered clinical isolates to antimicrobial drugs was determined using the disc diffusion (Kibry-Bauer) method. The sizes of inhibition zones were measured in millimeters with a ruler, and the agents examined were classed as susceptible, moderate, or resistant. In individuals with neurological deficits, seizure, or a Glasgow score of less than 11, a brain MRI conducted prior to the lumber puncture[8].

Patients were monitored on a daily basis to see if their symptoms improved or if they developed new ones. For the first 48 hours, vital signs were checked every four hours, then as needed after that. Follow-up on a daily basis using a neurosign chart that comprised the following variables: During the inpatient treatment, tests for (Glasgow coma scale (GCS), seizure, headache, and nuchal rigidity) were performed. At discharge, patients were evaluated for gross neurologic abnormalities (visual issues, hearing loss, and bodily weakness) as well as a mini-mental state test. The epidemiologic characteristics, clinical data and laboratory findings, causal organisms, and prognosis of all individuals with acute bacterial meningitis (ABM) were all thoroughly explored[9].

RESULTS

We gathered 350 patients for the study. A total of 110 people were diagnosed with acute bacterial meningitis (ABM) (As shown in Figure 1). Males (61.8 percent) were more likely than females (38.2 percent) to develop ABM. Patients from urban communities (70.0 percent) were affected far more frequently than patients from rural regions (30 percent). In 74.5 percent of patients with ABM, antecedent illnesses (i.e., any disease or condition that has caused another disease or condition in the morbid train of events leading to death) were discovered. The most common predisposing disease was pneumonia (33.6 percent). A positive history of antibiotic use in the days leading up to hospital admission was recorded by 60% of meningitis patients (As shown in Table 1). Figure shows the frequency of bacteria causing acute bacterial meningitis detected by cultures

Fever (90.9 percent) and headache were the most common clinical manifestations of ABM (88 percent). In individuals with meningitis, signs of meningeal irritation such as neck rigidity (90.9%), Kernig sign (72.7%), and Brudzinski sign (69%) are much higher. Meningitis is suspected when neck rigidity, headache, or both are present together with a fever (As shown in Table 2). Table 3 shows the Frequency of pathogens causing acute bacterial meningitis detected by CSG gram stain.

CSF leukocyte counts in the range of > 100 to 1,000 cell/mm3 were found in 79.1% of ABM patients, while CSF neutrophil percentages were found in 80% of ABM patients. CSF protein levels were increased in 85.5 percent of ABM patients (> 80 mg/dl). CSF glucose levels were lower in 81.8 percent of ABM patients (less than 50 mg/dl). CSF lactate levels were elevated in 90% of ABM patients (> 26 mg/dl). Pathogens were discovered in 95 cases (86.4 percent) of 110 CSF samples using a direct Gram-stained smear. Gram +ve bacteria were found in 55/110 (50%) of patients, while Gram -ve bacteria were found in 40/110 (36.4%).

Ampicillin-sulbactam (53 percent), cefotaxime (51.2 percent), and ceftriaxone (47.3 percent) were found to be effective antibiotics against gram + ve isolates in culture and sensitivity tests. For individuals with gram-ve isolates, vancomycin (70 percent), piperacillin/Tazobectum (28 percent), and levofloxacin (27.6%) were shown to be responsive antibiotics. In 73 (66.4 percent) of cases, blood cultures revealed the same pathogen as CSF cultures. In 14 (12.7 percent) of the instances, a distinct organism was found. Negative cultures were produced in 23 (20.9%) of the cases. If the patient was suspected meningitis with atypical presentation, an MRI was recommended before lumbar puncture. The following were discovered on MRI: - Obstructive hydrocephalic alterations at the level of the Silvius aqueduct, with dilated both lateral ventricles and an inflated third ventricle with a normal-sized fourth ventricle. Ventriculitis, as evidenced by thick ependymal enhancement in the ependymal lining of the lateral ventricles on post-contrast imaging, as well as debris visible in both lateral ventricles, producing fluid-fluid level. On T1 and T2 WI, these debris showed intermediate SI, limitation on DWI, and no enhancement on post-contrast investigations. Infarction along the middle cerebral artery (MCA) territory, which exhibited as wedge-shaped portions cortical and subcortical in position, with low SI on T1 and high SI on T2 and FLAIR images, and limitation on DWI. It had a mass impact, with the associated cortical sulci being effaced and the ipsilateral lateral ventricle being compressed. Subdural empyema manifested as a well-defined crescent extraaxial collection with low SI on T1 and high SI on T2 and FLAIR, limitation on DWI, and thick marginal enhancement on post-contrast imaging.

ABM had a high risk of death (22.7 percent). One 6-month-old child, one 40-year-old female patient, one 16-year-old girl, and all other instances were above 55 years old. Hearing loss, paralysis, cognitive sluggishness, and memory problems occurred in 21.8 percent of ABM patients (As shown in Table 4).

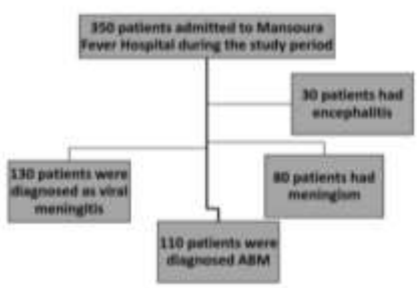

Figure 1: Frequency of acute bacterial meningitis in suspected meningitis patients

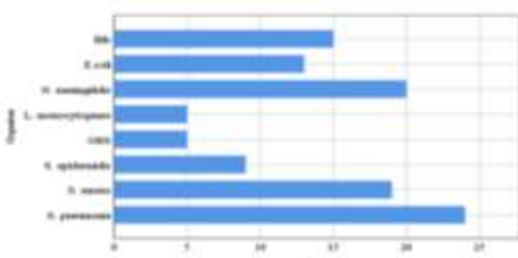

Figure 2: The frequency of bacteria causing acute bacterial meningitis detected by cultures

Table 1: Demographic data of acute bacterial meningitis patients (n=110)

Age (Yrs.) N (%)	
6 -12 month	5 (4.5%)
>1 -6	10 (9.1%)
>6 -18	12 (10.9%)
>18 -40	25 (22.7%)
>40 -60	30 (27.3%)
> 60	28 (25.5%)
Sex N (%)	
Male	68(61.8%)
Female	42 (38.2%)
Residence N (%)	
Urban	77 (70.0%)
Rural	33 (30.0%)
Antecedent illness N (%)	
Otitis media	16 (14.5%)
Sinusitis	21 (19.1%)
Pneumonia	37 (33.6%)
Tonsillitis	8 (7.3%)
None	28 (25.5%)
Spinal anesthesia N (%)	1 (0.9%)
Recent travel N (%)	6 (5.5%)
Antibiotic intake N (%)	66 (60.0%)

Table 2: Clinical Sign and Symptoms of the study participants

Clinical picture	Frequency	Percentage
Fever	100	90.9%
Headache	97	88.2
Vomiting	30	27.3%
Photophobia	18	16.4%
Neck rigidity	100	90.9%
Irritability	35	31.8%
Skin rash	10	9.1%
Altered consciences	18	16.4%
Seizures	16	14.5%
Kernig sign	80	72.7%
Brudzinski sign	76	69.1%
Local nerve signs	8	7.3%
AF bulge (N= 5)	3	60%
Abnormal cry (N= 10)	4	40%
Weak suckling (N= 8)	6	75%

Data is expressed as percentage and frequency. AF (anterior fontanel)

Table 3: Frequency of pathogens causing acute bacterial meningitis detected by CSG gram stain

Direct stained film	Frequency	%
Gram +ve cocci	25	22.7%
Gram +ve diplococci	20	18.2%
Gram +ve bacilli	5	4.5%
Gram +ve chain	5	4.5%
Gram –ve diplococci	17	15.5%
Gram – ve coccobacilli	13	11.8%
Gram –ve bacilli	10	9.1%
No detected strains	15	13.6%

Table 4: Prognosis of acute bacterial meningitis cases

Outcome	No.	%
Cured	61	55.5
*Died	25	22.7
**Sequalae	24	21.8

Data is expressed as percentage and frequency. *(One infant 6m, one female patient 40 years old, one girl 16 years old, and all other cases were above 55 years old). ** Most of these sequelae hearing deficit, paralysis, cognitive slowness, and memory trouble.

DISCUSSION

ABM was found in 31.43 percent of the population, while viral meningitis was found in 37.14 percent. Varied studies have different ratios meningitis. In a previous study conducted in Egypt, the majority of meningitis cases (42.86 percent) were likely viral, followed by bacterial meningitis with no positive culture growth (17.13 percent), and finally, with positive culture growth (5.08 percent)[10,11]. Another study, on the other hand, found a decreased rate of bacterial meningitis (10.3 percent)[12].

Differences in research locations and periods can explain the variation in bacterial and aseptic meningitis percentages[13]. For example, in developing countries, bacterial meningitis was the most common cause of meningitis, whereas in developed countries, particularly after the introduction of anti-capsular vaccines, bacterial meningitis became less common. ABM cases were dispersed across all age groups, which matched earlier findings.

Meningitis was found to be more common in infants and children in a prior study[14]. This could be attributable to environmental variables as well as the availability of vaccines for children against common viruses that cause meningitis, such as the H. influenzae vaccine for children introduced in the United States in 1990. Furthermore, because the majority of the infants and young children were referred to Mansoura University Child Hospital, the current study only included a small number of them, distorting the true picture of disease distribution. ABM patients had antecedent infections in about three-quarters of cases, with pneumonia being the most prevalent (33.6 percent). In a prior investigation, lung infections were found to be associated with meningitis caused by pneumococci in 40% of patients[15]

Clinical aspects provide a clue to a physician's early identification of ABM; thus, there are a variety of clinical symptoms that can aid in the diagnosis process[16]. The majority of patients had fever, headache, and stiff neck, which are all classic symptoms of bacterial meningitis. This was in line with earlier findings. Other indicators appeared at different rates in other studies. Atypical presentations are seen in some meningitis patients, such as newborns under the age of one year and the elderly. These neurologic signs are linked to the severity of the disease and the amount of time that has passed since the patient arrived at the hospital. As a result, none of the symptoms or indicators could accurately distinguish between patients with and without meningitis. Patients with a clinical suspicion of meningitis should be referred for a lumber puncture and CSF examination to confirm the diagnosis. Because of unusual presentation, 61 of the selected individuals were referred for MRI before LP. In individuals with acute bacterial meningitis, pathological MRI features such as leptomeningeal enhancement and hypointensity of subcortical white matter underlying severe meningeal inflammation are common[17]. In addition, non-contrast MRI sequences can reveal edema of the brain or enlargement of the extra-axial CSF spaces, which can be seen in meningitis[18]. The use of MRI in the diagnosis of patients with unusual presentations and their consequences is beneficial. Bacterial meningitis is a life-threatening condition with a high rate of fatality and morbidity[19]. Previous findings backed up this theory.

The case-fatality rate for bacterial meningitis without treatment can approach 70%, and one out of every five survivors may be left with long-term disability like hearing loss, cognitive dysfunction, or limb loss. Since the introduction of conjugate vaccines, the epidemiology of acute bacterial meningitis has changed dramatically[20].Even in developed countries, however, the disease continues to be a significant cause of morbidity and mortality.

We gathered a large number of patients. The diagnosis was made using very specific diagnostic criteria. For patients who had an unusual presentation, an MRI was performed. However, no association was observed between the MRI findings and the clinical presentation.

CONCLUSION

Acute bacterial meningitis is very common in patients presenting with suspected meningitis. The most prevalent pathogen was Streptococcus pneumoniae. Acute bacterial meningitis can afflict people of all ages. To avoid serious complications, doctors should not overlook the disease's unique appearance. A useful method for diagnosing uncommon cases is magnetic resonance imaging (MRI).

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