J Surg Med. 2019;3(7):464-468.
DOI: 10.28982/josam.524140

Research article
Araştırma makalesi

Journal of Surgery and Medicine
e-ISSN: 2602-2079

A review of bacteriological profile of acute pyogenic meningitis in a tertiary care center in Southwest Nigeria

Güneybatı Nijerya'da bir üçüncü basamak merkezde akut piyojenik menenjitin bakteriyolojik profilinin gözden geçirilmesi

Joseph Adejoke Adijat [1], Alao Michael Abel [2], Oladipo Tunde [1], Taiwo Samuel Sunday [3], Popoola Gbenga Olutade [4], Joseph Oluyemi Adesoji [5]

[1] Department of Medical Microbiology and Parasitology, Bowen University Teaching Hospital, Ogbomoso, Oyo state, Nigeria
[2] Department of Pediatrics, Bowen University Teaching Hospital, Ogbomoso, Oyo state, Nigeria
[3] Department of Medical Microbiology and Parasitology, Lautech Teaching Hospital, Ogbomoso, Oyo state, Nigeria
[4] Department of Psychiatry, Federal Teaching Hospital, Ido-Ekiti, Ekiti state, Nigeria
[5] Department of Sociology, University Of Ilorin, Ilorin, Nigeria

ORCID ID of the author(s)

JAA: 0000-0002-8316-4363
AMA: 0000-0003-0109-4435
OT: 0000-0002-9796-2235
TSS: 0000-0002-1495-9445
PGO: 0000-0003-2828-9558
JOA: 0000-0001-5677-5380

Corresponding author / Sorumlu yazar:
Joseph Adejoke Adijat
Address / Adres: Department of Medical Microbiology and Parasitology, Bowen University Teaching Hospital, Ogbomoso, Oyo state, Nigeria
e-Mail: adejokejoseph2012@gmail.com

Ethics Committee Approval: Approval to use patient's laboratory report was sought and received from the Ethical Review Committee of the teaching hospital and an informed consent was received from the parent and caregiver of the participants.
Etik Kurul Onayı: Hastanın laboratuvar raporunu kullanma onayı arandı ve eğitim hastanesinin Etik İnceleme Kurulundan alındı ve katılımcıların ebeveyni ve bakıcısından bilgilendirilmiş bir onay alındı.

Conflict of Interest: No conflict of interest was declared by the authors.
Çıkar Çatışması: Yazarlar çıkar çatışması bildirmemişlerdir.

Financial Disclosure: The authors declared that this study has received no financial support.
Finansal Destek: Yazarlar bu çalışma için finansal destek almadıklarını beyan etmişlerdir.

Published: 6/26/2019
Yayın Tarihi: 26.06.2019

Abstract

Aim: Pyogenic meningitis remain a major cause of mortality and morbidity in lower middle income countries. There exists a wide variability in antibiogram profile of infective causes of acute pyogenic meningitis seeking for individualized management protocol. This study aim to review a five years profile of isolates from suspected cases and evaluate the antibiogram of the infective agent in a tertiary hospital in South west Nigeria.

Methods: All patients presenting to the hospital with signs and symptoms suggestive of meningitis were evaluated. Aside random plasma glucose, CSF samples were sent for biochemistry, gene expert for tuberculosis and cultured on Blood agar, Chocolate agar and MacConkey agar for neonates and read after 24hours incubation.

Results: 393 of the 657,890 patients seen in the hospital over a five year period suspected to have meningitis were investigated, 22 (7%) had a positive culture. Streptococcus pneumoniae (31.8%), Haemophilus influenza (27.4%), other Enterobacteriaceae (18.2%), Pseudomonas aeruginosa (9.1%), Staphylococcus aureus (4.5%), Proteus mirabilis (4.5%) and Candida albicans (4.5%) were isolated.

Conclusion: Spectrum of causative bacterial agent is not different from documented in other parts of the country. Streptococcus pneumoniae predominance was reported which is sensitive to Ampicillin, Ceftriaxone, Cefotaxime and Penicillin. Empirical treatment with Ceftriaxone or Cefotaxime can be instituted while awaiting laboratory confirmation in suspected cases.

Keywords: Acute pyogenic meningitis, Lower middle income countries, Antibiogram, Southwest Nigeria

Öz

Amaç: Piyojenik menenjit, düşük orta gelirli ülkelerde önemli bir mortalite ve morbidite nedenidir. Bireyselleştirilmiş yönetim protokolü arayan akut piyojenik menenjitin enfektif nedenlerinin antibiyogram profilinde geniş bir değişkenlik vardır. Bu çalışmada, şüpheli vakalardaki izolatların beş yıllık bir profili gözden geçirilerek Güney Batı Nijerya'daki bir üçüncü basamak hastanede enfektif ajanın antibiyogramının değerlendirilmesi amaçlanmıştır.

Yöntem: Menenjit düşündüren belirti ve bulguları olan hastaneye başvuran tüm hastalar değerlendirildi. Rastgele plazma glukozunun yanı sıra, CSF örnekleri biyokimya, tüberküloz için gen uzmanı olarak gönderildi ve yenidoğanlar için Blood agar, Chocolate agar ve MacConkey agar üzerinde kültürlendi ve 24 saat inkübasyondan sonra okundu.

Bulgular: Hastanede menenjit geçirdiğinden şüphelenilen beş yıllık bir süre içinde görülen 657.890 hastanın 393'ü araştırıldı, 22'sinde (%7) pozitif kültür vardı. Streptococcus pneumoniae (%31,8), Haemophilus influenza (%27,4), diğer Enterobacteriaceae (%18,2), Pseudomonas aeruginosa (%9,1), Staphylococcus aureus (%4,5), Proteus mirabilis (%4,5) ve Candida albicans (%4,5) .

Sonuç: Nedensel bakteri ajanının spektrumu, ülkenin diğer bölgelerinde belgelenenlerden farklı değildir. Ampisilin, Ceftriaxone, Cefotaxime ve Penicillin'e duyarlı Streptococcus pneumoniae baskınlığı bildirilmiştir. Şüpheli vakalarda laboratuvar onayı beklenirken Ceftriaxone veya Cefotaxime ile ampirik tedavi uygulanabilir.

Anahtar kelimeler: Akut piyojenik menenjit, Düşük orta gelirli ülkeler, Antibiyogram, Güneybatı Nijerya

How to cite / Atıf için: Joseph AA, Alao MA, Oladipo T, Taiwo SS, Popoola GO, Joseph OA. A review of bacteriological profile of acute pyogenic meningitis in a tertiary care center in Southwest Nigeria. J Surg Med. 2019;3(7):464-468.

Introduction

Cerebrospinal Meningitis (CSM), inflammation of the meninges, is a medical emergency affecting all age groups. It is a common cause of mortality and morbidity in all age groups especially children and presents with fever, headache, meningismus, and altered mental status. Pyogenic bacterial meningitis remains a major cause of mortality and morbidity in lower middle income countries. It can be of infectious or non-infectious origin. Etiologic agents in infectious CSM vary with age and presence of underlying morbidity such as head trauma, recent neurosurgery, presence of a cerebrospinal fluid (CSF) shunt and immunocompromised state. The onset and extent of symptom is dependent on the clinical type; acute meningitis presents within hours to few days while subacute and chronic meningitis has a more gradual and insidious onset. The causative agent also varies depending on the clinical type [1]. The common etiologic agents of acute meningitis are viruses commonly the enteroviruses, but also HIV, mumps virus, and herpes simplex viruses and bacteria such as Streptococcus pneumoniae, Neisseria meningitidis, and Listeria monocytogenes. Less commonly, protozoa such as Naegleria fowleri and Angiostrongylus cantonensis may cause acute meningitis. Mycobacteria especially Mycobacterium tuberculosis, spirochetes such as Treponema pallidum and Borrelia burgdorferi, and fungi such as Cryptococcus neoformans and Coccidioides spp. are implicated in subacute and chronic meningitis and it is commonly associated with immunosuppression. Previous studies has shown the predominant etiologic agent for pyogenic meningitis in 90% of cases were N. meningitides, S. pneumonia and H. influenza type b. Meningitis due to Neisseria meningitidis has epidemic potential, causing the syndrome of epidemic cerebrospinal fever which was first described in Geneva by Vieusseaux in 1805 [2]. Subsequent reports throughout the 19th century confirmed its episodic, epidemic nature with a propensity for afflicting young children and military recruits assembled in stationary barracks situations.2 Epidemic CSM in Nigeria is seen in conditions of overcrowding [3].

Diagnosis of CSM is confirmed in the laboratory by the presence of CSF White blood cell count of 1000-5000/mm3 (range 100 to 10,000) 80% or more of which are neutrophils, raised CSF Protein value 100-500mg/dL raised CSF glucose of 40mg/dL, CSF-to-serum glucose ratio 0.4, Gram stain Positive in 60%-90% and Culture Positive in 70%-85%. The probability of isolating and identifying the etiologic agent is less than 50% where antibiotics have been instituted before presenting to the hospital or before sample collection. Within 24 to 36 hours of administration of appropriate antimicrobial agent, initially positive CSF cultures became sterile in 90% to 100% of patients especially infants and children [4].

The mortality rate of untreated bacterial meningitis approaches a 100%. Even with optimal therapy, morbidity and mortality may occur [5]. In infants and children, signs and symptoms of meningitis do not allow distinguishing the diagnosis and the causative agents though it has been documented that it is predominantly aseptic in this age group and bacterial origin in very few cases (10-20%) [6]. The presentation irrespective of the causative agent is the same but neurologic sequelae is more frequent following bacterial meningitis especially when treatment is not instituted early enough and or the antibiotics used is ineffective. Laboratory evaluation of CSF in suspected cases takes minimum of 48 hours to confirm diagnosis; this time is essential in the effective treatment and recovery of individuals with meningitis hence institution of empirical therapy before retrieving laboratory confirmatory result has been advocated. In many cases of bacterial CSM, the causative agent isn't recovered from clinical specimen hence specific antimicrobial susceptibility testing cannot be carried out and diagnosis relies on positive gram stain, suggestive CSF biochemical reports and clinical presentation while choice of antibiotics to treat with is the sole prerogative of the managing physician [6,7]. The pattern and spectrum of bacterial meningitis causative agent in this environment need be investigated, their antibiotic susceptibility profile known in order to influence the choice of antibiotic used in empirical therapy before a definitive treatment is instituted. With this background knowledge, a change in trend or deviation from the norm for this geographical location can easily be noted. It is also known that there exists a wide variability in antibiogram profile of infective causes of acute pyogenic meningitis seeking for individualized management protocol.

As at April 3, 2017, a total of 2,997 suspected cases of CSM have been reported in 16 States in Nigeria and the FCT. Affected states are, according to The Ministry of Health, Lagos, Osun, Zamfara, Kano, Katsina, Sokoto, Kebbi, Niger, Nasarawa, Jigawa, FCT, Gombe, Taraba, Yobe, Cross Rivers, Oyo, Plateau [8-10]. This study is a clinical and laboratory evaluation of isolates from 2,345 patients with suspected bacterial meningitis over a period of 5 years at Bowen University Teaching Hospital, Ogbomoso in Oyo state which is one of the states where CSM has been reported in Nigeria and also a referral Centre for the 33 local government area in the state and neighboring states. It equally evaluates the antibiogram of the infective agent in the tertiary hospital in South west Nigeria.

Materials and methods

All patients seen in different arms of the hospital from January 2013 to January 2018 with suspected meningitis were evaluated clinically. Clinical case definition was patient presenting with fever, headache, meningismus, and altered mental status for older children and adults while poor feeding or sucking, convulsion, vomiting and loss of consciousness were considered in infants and children less than 2 years of age. Appropriate laboratory investigations were individualized. Lumber puncture was carried out on all suspected cases of meningitis under aseptic technique. Specimens were evaluated macroscopically and microscopically.

Laboratory confirmation of diagnosis was organism seen on Gram staining of the CSF with or without a positive culture of the CSF, elevated CSF protein and reduced CSF glucose less than one-half of blood glucose.

Aside random plasma glucose, samples were sent for biochemistry and gene expert for Mycobacterium tuberculosis. Total white cell count (WBC) above 6 cells/ mm3 was designated significant for patient age above 28 days while a

WBC of 30cells/ mm3 was significant for neonates. Samples were cultured on Blood agar, Chocolate agar, and MacConkey agar for neonates and incubated overnight. Culture plates were kept for minimum of 48 hours before being labelled as culture negative. Gram staining was done on all isolates, catalase and coagulase tests for the gram positive isolates and indole, motility; citrate utilization test was carried out on the gram negative isolates.

Statistical analysis

Data entry and management were done with Microsoft Excel. All analyses and calculations were performed using SPSS software (Statistical Package for Social Sciences). Relationship between categorical variables was done using Chi square or Fisher's exact test and for continuous variables using Student's t-test and $P<0.05$ was taken as significant value.

Results

Of the 657,890 seen in the hospital over the five year period, 393 were suspected to have meningitis. Bacterial agent was isolated in 22(7%) (Figure 1). Implicated organisms were Streptococcus pneumoniae (31.8%), Hemophilus influenza (27.4%), other Enterobacteriaceae (18.2%), Pseudomonas aeruginosa (9.1%), Staphylococcus aureus (4.5%), Proteus mirabilis (4.5%) and Candida albicans (4.5%) (Table 1). Irrespective of the age and sex of the patient, the causative agents were not isolated in most of the cases (Table 2). In children aged less than 2 years, Hemophilus influenza as a causative agent of meningitis predominated (table 3), while Streptococcus pneumoniae was the predominant agent in the older child aged above 2 years and adults. Pseudomonas aeruginosa was the only isolate recovered in young adults aged 12 years to 18 years (Table 3). Isolates were variably sensitive to antibiotics tested; all isolated strains of Streptococcus pneumoniae was resistant to Augmentin, Ceftazidime, Chloramphenicol, Clindamycin, Erythromycin, and the Fluoroquinolones tested against it. Hemophilus influenza strains were likewise resistant to chloramphenicol, ceftazidime, cefuroxime, cotrimoxazole, ceftriaxone, cefotaxime, erythromycin, levofloxacin and penicillin. The other enterobacteriaceae isolates were also multiply resistant, resistance to chloramphenicol, ceftazidime, ceftriazone, cefotaxime, pefloxacin, cotrimoxazole and erythromycin were reported. Pseudomonas aeruginosa strains were resistant to chloramphenicol, ceftazidime, ceftriazone, cefotaxime, erythromycin, levofloxacin, pefloxacin, penicillin, cotrimoxazole. Staphylococcus aureus isolate was sensitive to all antibiotics tested except penicillin while Proteus mirabilis was sensitive to all except clindamycin, cotrimoxazole and tetracycline (Table 4).

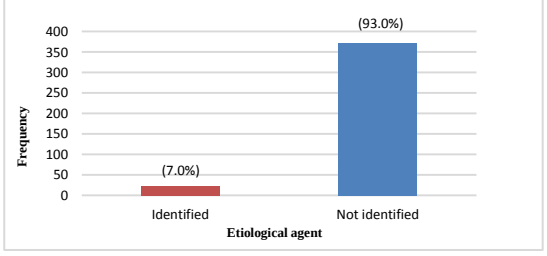

Figure 1: Frequency of isolation of etiologic agent

Table 1: Identified bacteria etiological agents of meningitis

Etiological agent	Frequency (n=22) n (%)
Streptoccocus pneumoniae	7 (31.8)
Haemophilus influenza	6 (27.4)
Other enterobacteriaceae	4 (18.2)
Pseudomonas aeruginosa	2 (9.1)
Staphyloccocus aureus	1 (4.5)
Proteus mirabilis	1 (4.5)
Candida albicans	1 (4.5)

Table 2: Identification of etiologic agent based on age and sex

Variable	Etiological agent Identified n (%)	Not identified n (%)	Total N (100.0%)	χ^2	*P*-value
Age					
0 – 1 month	2 (8.7)	21 (91.3)	23	0.432[Y]	0.994
>1 – 24 months	10 (8.4)	109 (91.6)	119		
> 24 – 60 months	3 (4.8)	59 (95.2)	62		
> 5 – 12 years	3 (8.3)	33 (91.7)	36		
> 12 – 18 years	1 (5.3)	18 (94.7)	19		
> 18 years	3 (5.4)	53 (94.6)	56		
Sex					
Male	9 (5.4)	158 (94.6)	167	1.392	0.238
Female	13 (8.8)	135 (91.2)	148		

χ^2: Chi square; Y: Yates Corrected Chi square

Table 3: Specific agents by age

Organism	Age group 0–1 month n (%)	1–24 months n (%)	>24–60 months n (%)	>5–12 years n (%)	>12–18 years n (%)	>18 years n (%)	Total n (%)
Streptococcus pneumoniae	1 (50.0)	2 (20.0)	0 (0.0)	2 (66.7)	0 (0.0)	2 (66.7)	7 (31.8)
Haemophilus influenza	0 (0.0)	5 (50.0)	1 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	6 (27.3)
Staphylococcus aureus	0 (0.0)	1 (10.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.5)
Pseudomonas aeruginosa	0 (0.0)	1 (10.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	2 (9.1)
Proteus mirabilis	0 (0.0)	0 (0.0)	1 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.5)
Candida albicans	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (33.3)	1 (4.5)
Other Enterobacteriaceae	1 (50.0)	1 (10.0)	1 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	4 (18.2)

Table 4: Antibiotic susceptibility profile of isolates

Antibiotics	Streptococus (n = 7) S n (%)	R n (%)	Hemophilus (n = 6) S n (%)	R n (%)	Enteriobacteriacea(n=4) S n (%)	R n (%)	Pseudomonas(n=2) S n (%)	R n (%)	Staphyloccocus(n=1) S n (%)	R n (%)	Proteus(n=1) S n (%)	R n (%)
Ampicillin (AMP)	4 (57.1)	3 (42.9)	1 (16.7)	5 (83.3)	3 (75.0)	1 (25.0)	0 (0.0)	2 (100.0)	O(0)	O(0)	0 (0.0)	1(100.0)
Augmentin(AUG)	0 (0.0)	7 (100.0)	3 (50.0)	3 (50.0)	1 (25.0)	3 (75.0)	0 (0.0)	0 (0.0)	O(0)	1(100)	1(100.0)	0 (0.0)
Ceftazidine(CAZ)	0 (0.0)	7 (100.0)	2 (33.3)	4 (66.7)	0 (0.0)	4 (100.0)	0 (0.0)	2 (100.0)	1(100)	O(0)	0 (0.0)	1(100.0)
Chloraphenicol (C)	1 (14.3)	5 (71.4)	0 (0.0)	6 (100.0)	0 (0.0)	4 (100.0)	0 (0.0)	2 (100.0)	1(100)	O(0)	0 (0.0)	1(100.0)
Ciprofloxacin (CIP)	1 (14.3)	6 (85.7)	5 (83.3)	1 (16.7)	4(100.0)	0 (0.0)	2 (100.0)	0 (0.0)	O(0)	O(0)	1(100.0)	0 (0.0)
Cefuroxime (CFX)	0 (0.0)	5 (71.4)	0 (0.0)	6 (100.0)	2 (50.0)	2 (50.0)	0 (0.0)	2 (100.0)	O(0)	O(0)	0 (0.0)	1(100.0)
Clindamicin(CL)	0 (0.0)	7 (100.0)	2 (33.3)	4 (66.7)	2 (50.0)	2 (50.0)	1 (50.0)	1 (50.0)	O(0)	O(0)	0 (0.0)	1(100.0)
Cotrimoxazole (COT)	1 (14.3)	5 (71.4)	0 (0.0)	6 (100.0)	2 (50.0)	2 (50.0)	0 (0.0)	0 (0.0)	O(0)	O(0)	0 (0.0)	1(100.0)
Ceftriaxone (CRO)	4 (57.1)	3 (42.9)	0 (0.0)	6 (100.0)	4 (100.0)	O(0)	2 (100.0)	0 (0.0)	1(100)	O(0)	1(100)	0 (0.0)
Cefotaxime (CTX)	2 (28.6)	4 (57.1)	0 (0.0)	6 (100.0)	4 (100.0)	O(0)	0 (0.0)	2 (100.0)	O(0)	O(0)	0 (0.0)	1(100.0)
Erythromycin (ERY)	0 (0.0)	6 (85.7)	0 (0.0)	6 (100.0)	0 (0.0)	4 (100.0)	0 (0.0)	2 (100.0)	1(100.0)	O(0)	0 (0.0)	1(100.0)
Gentamicin (GEN)	1 (14.3)	3 (42.9)	5 (83.3)	1 (16.7)	2 (50.0)	2 (50.0)	2 (100.0)	0 (0.0)	1(100.0)	O(0)	1(100.0)	0 (0.0)
Levofloxacin(LVX)	0 (0.0)	7 (100.0)	0 (0.0)	6 (100.0)	1 (25.0)	3 (75.0)	0 (0.0)	2 (100.0)	1(100.0)	O(0)	0 (0.0)	1(100.0)
Ofloxacin (OFL)	0 (0.0)	7 (100.0)	2 (33.3)	4 (66.7)	2 (50.0)	2 (50.0)	1 (50.0)	1 (50.0)	O(0)	O(0)	0 (0.0)	1(100.0)
Penicillin (PEN)	2 (28.6)	2 (28.6)	0 (0.0)	6 (100.0)	1 (25.0)	3 (75.0)	0 (0.0)	2 (100.0)	O(0)	O(0)	0 (0.0)	1(100.0)
Perfloxacin(PEF)	1 (14.3)	5 (71.4)	1 (16.7)	5 (83.3)	4 (100.0)	0 (0.0)	0 (0.0)	2 (100.0)	1(100.0)	O(0)	0 (0.0)	1(100.0)
Tetracycline (TET)	3 (42.9)	2 (28.6)	4 (66.7)	1 (16.7)	1 (25.0)	3 (75.0)	0 (0.0)	2 (100.0)	1(100.0)	O(0)	0 (0.0)	1(100.0)

Discussion

Seven percent of the 393 cases reviewed were confirmed by laboratory evidence of recovery of an isolate, this is similar to the report from a study carried out at the department of Child Health of the Royal Hospital where the records of 395 children suspected to have meningitis revealed only 7% of them to be abnormal [11].

Similar to the finding in this study is 5.2% recovery rate reported in National Hospital amongst children with suspected to have meningitis, and 6.2% reported at Ibadan [12,13]. This rate however is higher than the experience from Shagamu (2.8%), Maiduguri (3.5%) and Ilesha (1.6%) [14-16].

The low rate of isolating causative organism in meningitis reported in this study may be due to availability and assess to over-the-counter antibiotics and its commencement before sending samples to the laboratory, inappropriate use of antibiotics before presentation at the hospital, presence of nonculturable organisms as well as unfavorable culture conditions like erratic power supply, culture media not optimal hence can't support organism growth, transport conditions resulting in loss of viability of organism before it gets to the laboratory. Lack of microbiology resources for bacterial culture, and variable quality of microbiology services are among the reasons for culture negativity as stated by Ashraf et al. [5] Aseptic meningitis syndrome, a term used to define meningitis with a lymphocytic pleocytosis, for which a cause is not apparent

after initial evaluation and routine stains and cultures of CSF can also be the cause.

Isolates recovered were Streptococcus pneumonia, Hemophilus influenza, Pseudomonas aeruginosa, Staphylococcus aureus, Proteus mirabilis, and other members of the family enterobacteriaceae and Candida albicans. The commonest pathogen isolated was Streptococcus pneumoniae (31.8%). Streptococcus pneumoniae predominance is similar to the finding in southern Nigeria in the 70s where a 5 year review revealed N. meningitidis, S. pneumoniae, H. influenza and other organisms, including S. aureus and enterobacteriaceae as causes of bacterial meningitis. The tide however has changed in recent times as a 5 year review carried out in the 80s, 10 years after the previous review, at the same center in Benin, Nigeria showed that the same organisms were responsible for the 253 culture proven cases of bacterial meningitis, however, commonest isolate was N. meningitides (49.8%), replacing S. pneumoniae as the commonest bacterial cause of infectious meningitis [17].

In tandem with the finding of this report however is the result from a study carried out at the Royal care hospital in the UK in which the commonest pathogen was Group B Streptococcus (70%) [11]. In Ilorin also, Johnson found out that Streptococcus pneumoniae as a cause of bacterial meningitis predominated (78.6%) followed by Hemophilus influenza (7.1%), and Neisseria meningitides was the least recovered isolate (3.5%) [18]. Hemophilus influenza type b (Hib) was however the leading pathogen at University College Hospital (UCH) ibadan, found in 16 (55.1%) of the 29 cases of definite meningitis. Other isolates include Streptococcus pneumoniae (24.1%), Klebsiella spp (7.0%), Staphylococcus aureus (7.0%), Escherichia coli (3.4%) and Pseudomonas spp. (3.4%) [19]. The relative downregulation of meningitis due to N. meningitidis may be because of the presence of vaccination program against it and the success and widespread use of the vaccine in the susceptible age group.

Varying degrees of resistance to antibiotics was seen in this study, of particular note is the resistance to chloramphenicol seen in all organisms. This finding underscores the stoppage of chloramphenicol as a drug of first line treatment, empirical or therapeutic, of bacterial meningitis.

The recommended WHO treatment guideline for management of bacterial meningitis in non-epidemic situations is ceftriaxone once a day for 5–7 days, availability and affordability especially at peripheral centers is however a disadvantage [20]. In epidemic situations, the principle is a free, simple presumptive treatment, available at peripheral level and Oily chloramphenicol is recommended in countries when available, otherwise ceftriaxone.

According to the WHO document on Epidemic and Pandemic Alert and Response, in non-epidemic situations, laboratory identification of the bacteria in cerebrospinal fluid should be done to guide choice of antibiotic. However, in some countries within the African meningitis belt, laboratory investigation of suspected meningitis cases is often unavailable hence, treatment should be adapted to the most probable causative pathogen according to age of the patient. Since 1996, WHO has recommended the use of oily chloramphenicol (OC) for the presumptive treatment of meningococcal epidemics in peripheral health centers. OC is effective as a single dose (100 mg/kg), easy to use at district level (one intramuscular injection), has a low risk of misuse due to its limited indication. In epidemic situations however, the principle of presumptive treatment is instituted in which case, rapid identification of the pathogen(s) circulating is crucial for an effective response. Laboratory investigation of suspected meningitis cases should be standard practice at the beginning of the meningitis epidemic season. After identification of an isolate in 95% of cases of bacterial meningitis seen in health centers, systematic laboratory confirmation is no longer necessary, and treatment should be adapted to the most probable causative pathogen, which is that isolate [20].

The use of chloramphenicol however is supported by Sanya et al. [21] and Ozumba [22] following the favorable outcome reported at their centers when the drug was combined with crystalline penicillin. In the UCH Ibadan study, Hib and pneumococcus showed varying degrees of resistance to chloramphenicol, penicillin and cotrimoxazole as was reported in this review [19]. Hemophilus influenza, Neisseria meningitidis, Staphylococcus aureus and Escherichia coli were isolated in Ilesa, Osun state and all isolates were sensitive to both ceftriaxone and ciprofloxacin while the sensitivities to penicillin and ampicillin were remarkably low [23]. This is likely due to the availability and affordability of ampicillin hence its widespread abuse resulting in development of resistance.

Limitation of the study

Late presentation of cases to the hospital, after use of oral and parenteral antibiotics procured over the counter. Adult patients and caregivers of pediatric patients are not willing to concede to lumbar puncture to collect sample.

Conclusion

Spectrum of causative bacterial agent is not different from documented in other parts of the country. There is Streptococcus pneumoniae predominance which is sensitive to Ampicillin, Ceftriaxone, Cefotaxime and Penicillin. Hence in confirmed cases or suspected cases, empirical treatment with Ceftriaxone or Cefotaxime can be instituted while awaiting laboratory confirmation.

Recommendation

Frequent review of the causes of pyogenic meningitis and their antibiotic sensitivity pattern is desirable to identify changes and/or trends if any. A local guideline need be drawn to help in the diagnosis and treatment of bacterial meningitis in view of the changing susceptibility of isolates to common antimicrobial agents.

References

1. Allan RT, Diederik BW, Michael S. Acute Meningitis. Mandell, Douglas and Bennett's Principles and Practice of Infectious Diseases. Churchill Livingston Elsevier. 2010;1189.
2. Micheal AA. Neisseria menigitidis. Mandell, Douglas and Bennett's Principles and Practice of Infectious Diseases. Churchill Livingston Elsevier.2010; p. 2737-2752.
3. Terrie T. Emergency Plan of Action (EPoA) Nigeria: Meningitis. International Federation of Red Cross and Red Crescent Societies.2017. https:// www.adore.ifrc.org/Download.aspx?FileId=161742. Last Access date: 29 November 2018
4. Allan RT, Diederik BW, Michael S. Acute Meningitis. Mandell, Douglas and Bennett's Principles and Practice of Infectious Diseases. Churchill Livingston Elsevier.2010; pg 1208
5. Ashraf ES, Salma MA, Mikhail NM. Diagnosis of Major Bacterial Causes of Culture Negative meningitis in Children. Egypt J Med Microbiol. 2014;23:47-57.
6. Syamal M, Amit KA. Phenotypic Characterization And Antibiogram Of CSF Isolates In Acute Bacterial Meningitis. J Clin Diagn Res. 2013;12:2704–8.
7. Mohammad ZA. Prevalence and rapid diagnosis of acute bacterial meningitis in children in Bangladesh.2018. https://www.omicsonline.org/proceedings/prevalence-and-rapid-diagnosis-

of-acute-bacterial-meningitis-in-children-in-bangladesh-100459.html. Last acces date: 26 June 2019

8. Remmy A. Meningitis: List Of States Affected By Deadly Disease In Nigeria, 2017. https://www.nigerianbulletin.com/threads/meningitis-list-of-states-affected-by-deadly-disease-in-nigeria.236534. Last access date: 01 May 2019
9. FMOH. Nigeria: Meningitis Outbreak. 2017. https://reliefweb.int/disaster/ep-2017-000030-nga. Last access date: 26 June 2019
10. Lawal B. Federal Government of Nigeria and Partners Ramp up response to Meningitis C Outbreak.2017. https://reliefweb.int/report/nigeria/federal-government-nigeria-and-partners-ramp-response-meningitis-c-outbreak. Last access date 5 April 2019
11. Thomas V, Riaz A and Qasim S. Cerebro Spinal Fluid Analysis in Childhood Bacterial Meningitis. Oman Med J. 2008;23:32–33.
12. Kenneth CI and Abdullahi N. Profiles of acute bacterial meningitis isolates in children in National Hospital, Abuja. Niger Med J. 2015;56:297–300.
13. Alausa OK, Onile BA. The pattern of bacterial meningitis in Ibadan (A 21-month prospective study) Niger Med J. 1984;14:167–70
14. Akpede GO, Adeyemi O, Abba AA, Sykes RM. Pattern and antibiotic susceptibility of bacteria in pyogenic meningitis in a children's emergency room population in Maiduguri, Nigeria, 1988-1992. Acta Paediatr. 1994;83:719–23.
15. Fagbule D, Joiner KT. Pattern of childhood mortality at the University of Ilorin teaching hospital. Niger J Paediatr. 1987;4:1–5.
16. Ojinaka NC, Iloeje SO. Neurological complications of childhood bacterial meninigitis as seen in Enugu. Niger J Paediatr. 1998;25:53–6.
17. Akpede OI, Abiodun PO, Sykes M, Salami CE. Childhood bacterial meningitis beyond the neonatal period in southern Nigeria: changes in organisms/antibiotic susceptibility. East Afr Med J. 1994;71:14-20.
18. Johnson WB, Adedoyin OT, Abdulkarim AA, Olanrewaju WI.Bacterial pathogens and outcome determinants of childhood pyogenic meningitis in Ilorin, Nigeria. Afr J Med Med Sci. 2001;30:295-303.
19. Lagunju IA, Falade AG, Akinbami FO, Adegbola R, Bakare RA.Childhood bacterial meningitis in Ibadan, Nigeria--antibiotic sensitivity pattern of pathogens, prognostic indices and outcome. Afr J Med Med Sci. 2008;37:185-91.
20. World Health Organization. Epidemic and pandemic alert and response. Standardized treatment of bacterial meningitis in Africa in epidemic and non epidemic situations. 2007. www.who.int/csr/resources/publications. Last access date: 4 April 2019
21. Sanya E, Taiwo S, Azeez O, Oluyombo R. Bacteria Meningitis: Problems Of Empirical Treatment In A Teaching Hospital In The Tropics. J Infect Dis. 2006;6:1.
22. Ozumba UC. Acute bacterial meningitis in Enugu, Nigeria. 1 April 1989 to 31 March 1993. Cent Afr J Med. 1995;41:54-9.
23. Ogunlesi TA, Okeniyi JA, Oyelami OA. Pyogenic meningitis in Ilesa, Nigeria. Indian Pediatr. 2005;42:1019-23.

The National Library of Medicine (NLM) citation style guide is used in this paper.
Suggested citation: Patrias K. Citing medicine: the NLM style guide for authors, editors, and publishers [Internet]. 2nd ed. Wendling DL, technical editor. Bethesda (MD): National Library of Medicine (US); 2007-[updated 2015 Oct 2; cited Year Month Day]. Available from: http://www.nlm.nih.gov/citingmedicine