

The aetiology of acute community acquired bacterial meningitis in children and adults in Maputo, Mozambique

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Abstract

Background: Community-acquired acute bacterial meningitis is a life-threatening infection and many outbreaks have been reported all around the world.

Methodology: We analysed 330 cerebrospinal fluid (CSF) samples received over a period of eight months from patients older than one month. Microscopy, cultures, identification, and antigen detection were performed for the positive samples.

Results: *Neisseria meningitidis*, *Streptococcus pneumoniae* and *Haemophilus influenzae* type b were isolated in 5.4%, 4.8%, and 3.6% of CSF samples respectively.

Conclusions: Our findings indicate that *N. meningitidis* is the most common cause of acute bacterial meningitis in Mozambique and that *H. influenzae* type b was isolated only from children aged younger than six years. This is the first study to provide data on the aetiological agents of acute bacterial meningitis in children and adults in Mozambique.

Keywords: Community-acquired meningitis, Mozambique

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Introduction

Community-acquired acute bacterial meningitis is a severe and life-threatening infection if not diagnosed early and treated appropriately [1]. *Neisseria meningitidis*, *Haemophilus influenzae* type b and *Streptococcus pneumoniae* are the most common causes of acute bacterial meningitis in developing countries [2]. Bacterial meningitis caused by *H. influenzae* type b and *S. pneumoniae* have been declining in the developed countries as result of the introduction of specific vaccines [1].

N. meningitidis, a Gram-negative diplococcus, is a major cause of community-acquired acute bacterial meningitis worldwide [1,3,4,5]. This bacterium is divided into 13 serogroups based on the antigenicity of the polysaccharide capsule [6]. Serogroups A, B, C, W135, Y, and X are associated with seasonal outbreaks [3]. Genetic recombination has been reported to play a role in the emergence of these outbreaks [1]. In the African meningitis belt, epidemic meningococcal infections caused an estimated 700,000 cases with a mortality rate of 10%

in the last 10 years [7]. *N. meningitidis* causes bacterial meningitis in 80-95% of cases during epidemic periods and up to 50% in non-epidemic situations in the above mentioned African area [8,9,10].

H. influenzae type b and *S. pneumoniae* are commonly isolated in patients presenting with meningitis in countries where the new conjugated vaccines are not in use [1]. *S. pneumoniae* is a major cause of otitis media, pneumonia, and meningitis in all age groups [11], while *H. influenzae* type b is isolated mainly from patients younger than 6 years presenting with the same diseases [12]. These two pathogens have assumed an even more important role as causative agents of serious infections in patients infected with human immunodeficiency virus (HIV) [13].

In the absence of reliable data on the prevalence of *S. pneumoniae* and *H. influenzae* type b infections in many developing countries, it is difficult for National Health Programs to motivate authorities to

Table 1
Aetiology of acute community bacterial meningitis at Maputo Central Hospital

Causative agent	Number	Percentage
<i>Neisseria meningitidis</i>	18	5.4
<i>Streptococcus pneumoniae</i>	16	4.8
<i>Haemophilus influenzae</i> type b	12	3.6
Negatives	284	86.2

implement vaccines against these two important pathogens. In Mozambique, very little is known about the extent of burden of disease attributed to community-acquired acute bacterial meningitis [2,19]. The main objective of this study, therefore, was to determine the aetiology of community-acquired acute bacterial meningitis in patients older than one month presenting to the Maputo Central Hospital.

Materials and Methods

Cerebrospinal fluid (CSF) samples were received from patients older than one month in the microbiology laboratory at the Maputo Central Hospital between August 2007 and March 2008. The samples were centrifuged at 3,000 rpm for 10 minutes. The supernatant was aseptically removed, and a Gram stain performed on the deposit. A drop of the remaining CSF was inoculated onto blood and chocolate agar. The two plates were incubated in a candle jar at 35°C for 24-48 hours.

A Gram stain was performed from all positive cultures. An oxidase test was performed on all isolates of Gram-negative diplococci, which were then further identified as pathogenic *Neisseria* by determining the absence of growth on a chocolate agar plate incubated at room temperature. Gram-negative coccobacilli resembling *Haemophilus* were tested for X, Y and XY factor requirement on nutrient agar plates incubated at 37°C in candle jars. *S. pneumoniae* was identified on the basis of the Gram stain appearance and colony morphology; susceptibility to optochin was tested on subculture in blood agar plate placed with this disc on the initial streak.

The Wellcogen Bacterial Antigen Kit (Remel Europe Ltd) for *N. meningitidis* A, C,Y, W135 and B/E. *coli* K1, *H. influenzae* type b, *Streptococcus* group B, and *S. pneumoniae* was used to confirm the identification of isolates of Gram-positive diplococci,

Gram-negative diplococci and Gram-negative coccobacilli.

Results and Discussion

A total of 330 CSF samples were processed in the microbiology laboratory during the period August 2007 to March 2008. These samples were received from patients in the Pediatrics, Medicine, Intensive Care Unit, and Gynecology departments of Maputo Central Hospital. The patients' ages varied from one month to 68 years. Of the 330 CSF samples received, 46 (13.8%) were positive on culture (Table 1). *H. influenzae* type b was cultured from 12 (3.6%) samples, *S. pneumoniae* was cultured from 16 (4.8%), and *N. meningitidis* was cultured from 18 (5.4%). With the exception of two patients for whom the age was not available, *H. influenzae* type b isolates were recovered only from children younger than 6 years (*P* value of 0.0004). *S. pneumoniae* was evenly distributed in all age groups. *N. meningitidis*, however, was more commonly isolated from patients aged one to 20 years (*P* value is 0.007) (Table 2). The age was not indicated for 55 patients, two of whom were infected with *H. influenzae* type b meningitis.

The diagnosis of acute bacterial meningitis in many developing countries is usually based on clinical and basic laboratory criteria (i.e., CSF microscopy and chemistry) because of the lack of qualified personnel and minimally equipped microbiology laboratories. It is therefore not surprising that information on the aetiology of acute bacterial meningitis is not readily available in such countries including Mozambique. With the introduction of highly effective conjugate polysaccharide vaccines against *H. influenzae* type b and *S. pneumoniae*, it is essential that such information be available in developing countries [1].

In the present study, 13.9% of CSF samples were culture positive for aetiological agents of acute bacterial meningitis. This observation is in keeping

Table 2

Relationship between patient age and causative agents of bacterial meningitis at Maputo Central Hospital

Patient age	<i>H. influenzae</i> type b		<i>S. pneumoniae</i>		<i>N. meningitidis</i>		Total of patient
Years	n	%	n	%	n	%	n
<1	7	2.1	4	1.2	2	0.6	78
1 to 5	3	0.9	1	0.3	4	1.2	52
6 to 10	0	0	1	0.3	6	1.8	17
11 to 20	0	0	1	0.3	2	0.6	20
>20	0	0	2	0.6	1	0.3	108
No age	2	0.6	7	2.1	3	0.9	55
Total	12	3.6	16	4.8	18	5.4	330

with the findings of the only other study reported from Mozambique from Manhiça district [2], in which 15% of the patients had culture proven meningitis. However, the latter was performed only in patients aged younger than 15 years living in rural area. The previous study also reported that *S. pneumoniae*, *H. influenzae*, and *N. meningitidis* were the most common bacteria isolated from the patients presenting with signs of meningitis [2].

We found *N. meningitidis* to be the commonest isolate, which contrasts with findings of the study reported from Manhiça district of Mozambique, where it was found to be the third commonest cause and was isolated in only 1.6% of CSF samples [2]. Furthermore, *N. meningitidis* in the present study was isolated significantly more frequently in the age group one to twenty years.

It has also been reported that more than 50.0% of cases of meningococcal meningitis occur in sub-Saharan African countries including Mozambique [15,16], and yet a vaccine against this bacterium is still not part of the routine vaccination program in Mozambique [2].

S. pneumoniae was found to be the second commonest cause of acute bacterial meningitis, accounting for 4.8% of positive cultures. In contrast, Sigauque *et al.* [2] reported 6.5% of meningitis cases caused by this organism, which in their study was found to be the commonest cause in children. *S. pneumoniae* has also been reported to be the commonest cause of acute bacterial meningitis in other published studies from elsewhere in the world,

which led to the introduction of conjugated polysaccharide pneumococcal vaccine in many developed countries and resulted in a significant decline of invasive pneumococcal infection [1,14]. The pneumococcal serotypes found in Mozambique are currently unknown and need to be urgently addressed in future studies. This information will prove invaluable in determining whether currently available pneumococcal vaccines will adequately cover serotypes prevalent in Mozambique.

In the present study, *H. influenzae* type b was found in 3.6% of CSF samples, and all positive cultures were in children younger than six years (Table 2), which is in keeping with other reports [2,12]. However, we found a higher incidence in comparison with that reported by Sigauque *et al.* [2], who found *H. influenzae* in only 2.7% of CSF samples. Both these studies, however, confirm the continuing importance of *H. influenzae* type b as a cause of meningitis in children aged younger than six years in Mozambique. The government of Mozambique must consider introducing the conjugated *H. influenzae* type b vaccine as part of the routine vaccination program.

It is well recognized that early and appropriate therapy impacts on morbidity and mortality from acute bacterial meningitis [17,18]. A major limitation of this study is the lack of data on antimicrobial resistance of meningeal isolates to commonly used antibiotics in the treatment of meningitis in Mozambique. Currently, penicillin or ampicillin and chloramphenicol are used in the empirical treatment of acute bacterial meningitis in Mozambique.

In conclusion, we believe that further studies are urgently required not only to determine the antimicrobial resistance profile of meningeal isolates in Mozambique, but to also determine the serotypes of these isolates. Information on serotypes will prove invaluable in determining whether currently available vaccines, particularly those against *S. pneumoniae* and *N. meningitidis*, will provide adequate coverage for the population of Mozambique.

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