

Changing Pattern of Childhood Epidemic Cerebrospinal Meningitis in North-Western Nigeria

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ABSTRACT

Introduction: Nigeria lies within the meningitis belt which extends from the Gambia, Senegal through Nigeria to Eritrea; however, outbreaks have been shown to extend further south involving countries such as Angola and Namibia. Epidemic outbreaks are often recorded every 8–12 years averaging in a 10 yearly circle however endemic cases still occurs. **Materials and Methods:** The study was retrospective; all results of cerebrospinal fluid (CSF) samples of children with cases of meningitis from January 2010 to December 2010 were collected from the register of the microbiology laboratory of General Hospital Gusau. Relevant information such as their age, sex, CSF macroscopy/microscopy reports, latex particle agglutination test report, and CSF culture report were retrieved and entered into a pro forma. **Results:** There were 89 (73%) males and 33 (27%) females with male to female ratio of 2.7:1. The age ranged from 2 months to 14 years; the mean was 6.27 ± 4.00 years. Meningitis was mostly recorded from January to April. W135 was the most common serotype identified. Majority of the samples (54) which were nonreactive for any of the tested antigens had clear CSF (36), while among those that reacted; the W135 group had a high proportion of cases that had turbid CSF (44); (Fisher’s exact test = 30.650, $P = 0.000$). Majority of the samples (99) had no cell count; although those of the W135 group had higher cell counts followed by those in the nonreactive group (Fisher’s exact test = 11.226, $P = 0.181$). **Conclusion:** Meningitis was highest between January and April, and W135 was the most common serotype.

KEYWORDS: Cerebrospinal fluid culture, epidemic meningitis, latex agglutination, meningitis belt, serotypes

INTRODUCTION

Nigeria lies within the meningitis belt which extends from the Gambia, Senegal through Nigeria to Eritrea; however, outbreaks have been shown to extend further south involving countries such as Angola and Namibia.^[1,2] Epidemic outbreaks are often recorded every 8–12 years averaging in a 10 yearly circle;^[3] however, endemic cases still occurs.^[4-6] *Neisseria meningitidis* is the commonest organism implicated in epidemic meningitis, and 9 serotypes have been identified; these are, namely, A, B, C, D, X, Y, Z, W-135, and 29 E; however, group A and occasionally group C are implicated in most epidemics in sub-Saharan Africa;^[7] in an earlier report by Mado

et al.^[8] 77 cases of cerebrospinal meningitis (CSM) were documented over a 12-month period (2009) in their tertiary institution; however, their result showed that *N. meningitidis* serogroup A was positive in all of the 77 cerebrospinal fluid (CSF) sampled through latex particle agglutination test (LPA); however, only five positive CSF cultures for *N. meningitidis* were obtained and an additional five patients had nonmeningococcal meningitis during the epidemics (three pneumococcus and two *Haemophilus influenzae*). The serotype A had been documented as the predominant strain in most

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reports of outbreaks in northern Nigeria and Niger Republic.^[9] However, this differed from that of Osuorah *et al.*^[10] who reported more of W135 in an outbreak in the Gambia in 2012. However, in 2010, large pool of samples was received from several health facilities in Zamfara state and beyond with diagnosis of meningitis; this study, therefore, seeks to determine the organisms implicated, the serotypes involved and if there was any change in the serotype from those reported in the previous year. Identifying the responsible serotype has important disease preventive role in implementing effective surveillance and vaccination programs.

MATERIALS AND METHODS

The study was retrospective; all results of CSF samples of children with meningitis collected from January 2010 to December 2010 were collected from the register of the microbiology laboratory of General Hospital Gusau. The relevant information such as their age, sex, CSF macroscopy/microscopy reports, LPA test report, and CSF culture report were retrieved and entered into a pro forma. Approval for this study was obtained from the State Ethical Committee on clinical research. The Farida General Hospital Gusau laboratory was the reference center for CSF analysis for the state and its being supported by Federal Ministry of Health, State Ministry of Health and World Health Organization (WHO), so all samples are sent from all health facility and standard WHO protocol for case definition and laboratory procedures are highly maintained.

Materials needed for sample collection

Common materials used were: Trans isolate transport medium (Ti), CSF sampling Kit (L/P kits), and refrigerator for keeping Ti bottles before inoculation.

Sample collection procedure

Before sample collection, the main laboratory was routinely notified; samples were collected by the managing medical officers at referring centers through aseptic technique using the provided LP kit, and 3 ml of CSF were added into sterile CSF containers. Samples collected were transported either by laboratory staffs to the main laboratory; the average time to the main laboratory from the most distant health center was about 40 min. However, considering the fact that the most common etiologic agents of CSM from a previous study^[8] are fastidious, 0.5 ml of CSF samples were inoculated onto Trans Isolate Media and the blood onto Brain Heart Infusion Broth immediately after collection when delay in transportation was envisaged.

Other laboratory assays conducted

Pastorex latex agglutination test

Rapid diagnosis (for *Streptococcus pneumoniae* and characterization of specific serogroup for *N. meningitidis*) based on antigen-antibody test. An equal volume of CSF and antibody was placed on the mat, this is mixed rocked for 15 min, and the presence of agglutination indicates positivity for the specific organism.

Gram and India ink staining

CSF was centrifuged (1500 × g) for 15 min and Gram stain was performed on the centrifuged deposit. One drop of India ink was mixed with one drop of CSF sediment and this was examined under a light microscope, using low (×10) and high dry (×40) magnification for fungal studies. Gram stain and India ink results were reported within 2 h to clinicians.

Cerebrospinal fluid culture procedure

The basic materials for the CSF culture were Loops, Bacti-cinerator, incubator and Co₂ jar; while the media used were blood agar (5% sheep or horse blood), MacConkey plates or Chocolate agar with *Staphylococcus aureus* streak. Standard procedures were followed and in-house quality control measures were ensured. The CSF sediments were inoculated onto two blood agar plates, and streak of *S. aureus* was added on one of the blood agar to promote the growth of *H. influenzae*; these were incubated at 35°C–37°C. Blood agar plate was incubated under aerobic and anaerobic condition at 37°C. All media were incubated for 2 days, with daily inspection. However, if after 24 h and there was no growth, we re-incubated for an additional 24 h.

Reporting reference limits

- Preliminary reports after 24 h were sent to the attending physician: “No growth after 24 h’ incubation” or “growth after 24 h’ incubation. Antibiotic susceptibility results to follow”
- The final results were issued when definitive organism identification and antibiotic test results were available.

Statistical analysis

Obtained data was cleaned and entered into Statistical Package for Social Sciences, (SPSS) version 20; (IBM SPSS Corp Armonk, New York, United State of America). The data were presented as tables, graphs, and frequencies. Test of significance using the Fisher’s exact test was deployed with $P < 0.05$ been set as statistically significant.

RESULTS

There were 89 (73%) males and 33 (27%) females with male to female ratio of 2.7:1. The age range of the individuals was from 2 months to 14 years; the mean age was 6.27 ± 4.00 years.

Samples for cases of meningitis were mostly recorded from January to April and the highest record was March (89; 73%) while April (1; 0.8%) had the least; February and January had 28 (23%) and 4 (3.3%), respectively [Figure 1].

Majority of the samples were received from subjects who were within their childhood (36.1%) while infants were the least (13.1%). Most of the samples were from participants within the 1–5 years of age group (41.8%) while those <1 year were the least (6.6%) [Table 1].

Most of the samples were turbid at submission (74; 60.7%) while 48 (39.3%) were clear. The mean cell count was $0.8 \times 10^9/L \pm 1.9 \times 10^9/L$; absent cell (81.1%) in the CSF was the most common observation, while only 9 (7.4%) samples had more than 5 cells in the CSF [Table 2].

N. meningitidis serotype W135 was the most common serotype identified, while 44.3% of them were nonreactive, serotype A was the least recorded.

Majority of the samples (54) which were nonreactive for any of the tested antigen had a clear CSF (36), while among those that were reactive; the W135 group had high proportion of cases that had turbid CSF (44); this observation was noted to be statistically significant (\ddagger Fisher's exact test = 30.650, $P = 0.000$).

Higher proportion (62) of the samples with absent cells appeared turbid at submission, however, all the samples with the highest cell counts were turbid at presentation, this observation was not statistically significant (\dagger Fisher's exact test = 6.006, $P = 0.091$) [Table 3].

Majority of the samples (99) had no cell count (0) although those of the W135 group had higher cell counts followed by those in the nonreactive group,

however it was not statistically significant (Fisher's exact test = 11.226, $P = 0.181$) [Table 4].

DISCUSSION

Meningococcal disease outbreaks occur in the semi-arid region of sub-Saharan Africa which has been described

Table 1: Demographic characteristics of the study group

	Frequency (%)
Developmental stage	
Infants	16 (13.1)
Toddlers	19 (15.6)
Childhood	44 (36.1)
Older age	43 (35.2)
Total	122 (100)
Age-group	
<1	8 (6.6)
1-5	51 (41.8)
6-10	42 (34.4)
>10	21 (17.2)
Total	122 (100)

Table 2: Cell count and serotypes of the obtained cerebrospinal fluid

	Frequency (%)
Cell count	
0	99 (81.1)
≤5	14 (11.5)
>5	9 (7.4)
Total	122 (100)
Serotype	
A	5 (4.0)
W135	55 (45.1)
<i>Streptococcus pneumonia</i>	8 (6.6)
Nonreactive	54 (44.3)
Total	122 (100)

Table 3: Comparing the serotypes and cell count with the cerebrospinal fluid turbidity

	Turbidity		Total
	Clear	Turbid	
Serotypes [‡]			
A	0	5	5
W135	11	44	55
<i>Streptococcus pneumonia</i>	1	7	8
Nonreactive	36	18	54
Total	48	74	122
Cell count [†]			
0	37	62	99
<5	9	5	14
>5	2	7	9
Total	48	74	122

[‡]Fisher's exact test=30.650, $P=0.000$; [†]Fisher's exact test=6.006, $P=0.091$

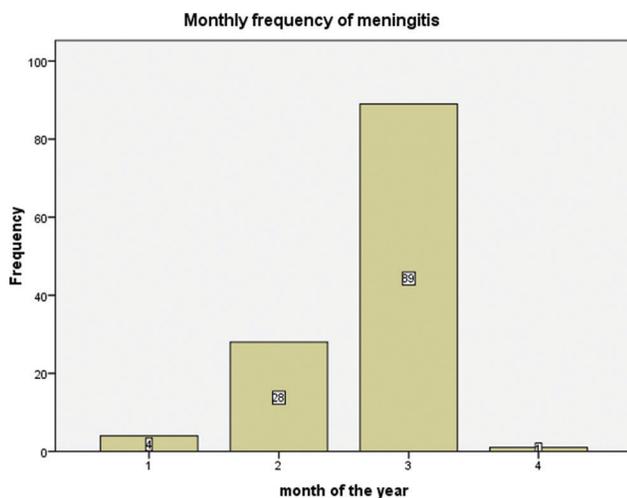


Figure 1: Monthly distribution of cases of meningitis

Table 4: Comparing the serotypes with the cell counts

Serotypes	Cell count			Total
	0	<5	>5	
A	4	0	1	5
W135	44	4	7	55
<i>Streptococcus pneumoniae</i>	6	2	0	8
Nonreactive	45	8	1	54
Total	99	14	9	122

Fisher's exact test=11.226, $P=0.181$

by the WHO as the meningitis belt; northern Nigeria lies within this description, therefore, reports of epidemics are not uncommon; however, infection caused by other strains of bacteria and nonbacterial organisms are also observed in the region. Outbreaks of CSM often occur during the hot season between December to June.^[11]

This study showed that more males were affected than females, this observation was similar to that reported by Tavasoli *et al.*^[12] and Heydarian *et al.*^[13] both in Iran; similarly, Lagunju *et al.*^[14] in Ibadan and Frank-Briggs and Alikor^[15] in Port-Harcourt reported the same pattern of male predominance; why this is so is not clearly understood, however, the role of sex variation in the development of the immune system and susceptibility to various bacterial infection as was reported by Green^[16] is plausible.

Samples were mostly received from January to April and March had the highest; this observation was slightly different from the previous reports;^[17,18] Mado *et al.*^[8] in the 2009 CSM outbreak, cases were recorded up to May; and April recorded the highest cases followed by March.

The W135 serotype was the predominant strain in this study; this was a great departure from previous reports^[8,9] which showed A serotype as the most common cause of outbreak; however, our result was similar to that of Osuorah *et al.*^[10] in their report from the Gambia. The world is a global village; with the ease of travel introduction of alien serotypes is not an uncommon phenomenon.

The age distribution in this study was similar to the previous reports of Odedina and Emumwen,^[19] Mado *et al.*^[8] (those <1 year constituting 6.6%) and Emele and Anyiwo^[20] but contrasted with that of Mohammed *et al.*^[21] and Bwala *et al.*^[22] who reported high incidence in infancy. They attributed their experience to the impact of virulence of the subgroups involved in their outbreak.

Seventy-four (60.7%) of the sample were reported turbid; this was higher than the 2% reported by Odedina and Emumwen;^[19] the reason for the difference was not clear, however, turbidity is subjective, therefore milder grades of severity are often prone to either been under

or overestimated. However, the culture yield was low in this study when compared to 6.5% by Mado *et al.*^[8] and 14% by Odedina and Emumwen;^[19] no positive culture was obtained in this study.

Ninety-nine (81.1%) of the samples had absent neutrophil in the CSF; absent CSF neutrophilic pleocytosis has been associated with meningococcal meningitis,^[23] especially following early lumbar puncture sampling; therefore, repeat sampling is advised in such settings. Furthermore, our laboratory received samples from distant health facilities; therefore, the possibility of degradation was also entertained.

CONCLUSION

This study showed that epidemic meningitis was highest between January and April, and the predominant serotype (W135) was a great departure from the usual; therefore, this highlights the significant of continuous surveillance, which facilitates efficient vaccination program.

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Conflicts of interest

There are no conflicts of interest.

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