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Research Article
Epidemiological, Cytochemical and Bacteriological Profile of Meningitis among Adults and Children in North West of Morocco

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Abstract

Background and Objective: Meningitis is a medical and public health problem in Morocco, particularly in the North West region. The purpose of present study was to identify the pathogen in pyogenic meningitis and to determine its antibiotic susceptibility pattern **Materials and Methods:** A total of 247 cases were included in the diagnosis of meningitis on the basis of clinical findings and positive cerebrospinal fluid (CSF). **Results:** The study included 247 cases with a mean cumulative incidence of 4.53 (100,000 Hts) meningitis in all forms during the study period. The sex ratio M/F was 1.71. Maximum numbers of cases were<15 year of age, 139 (56.3%). Bacterial meningeal syndrome was observed in 67.2% of cases. Cerebrospinal fluid (CSF) was cloudy in 57.1% of cases. The average number of GBs was 1074.12 (±2115.63) elements mm^{-3}. Mean glycorrhachia was 0.48 g L^{-1} (±0.28) and mean protein levels were 1.5 g L^{-1} (±1.68). The common pathogens identified on CSF culture were coagulase, negative *Neisseria meningitidis* in 30 (13%) and *Streptococcus pneumoniae* 6 (2.5%). Overall mortality was 14.9%. **Conclusion:** Hence, Meningitis is a real health problem in the province of Kenitra, affecting especially children. Effective involvement of all health personnel and the community fight this epidemic disease.

Key words: Meningitis, epidemiology, cerebrospinal fluid, *Streptococcus pneumoniae*, cerebrospinal fluid

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Meningitis is a very serious infection of the meninges that surround the brain and the spinal cord[1]. It is usually caused by viral, bacterial or fungal pathogens. Bacterial meningitis can be quite severe and may result in brain damage, hearing loss, learning disability and death if not treated early[2].

Acute viral meningitis is the leading cause of aseptic meningitis, the diagnosis being strongly suspected in case of clear, sterile, normoglycorrhachic CSF with clearly lymphocytic predominant cellularity[3].

Bacterial meningitis remains a major cause of mortality and long term neurological sequelae worldwide. Bacterial meningitis remains a major cause of mortality and long term neurological sequelae worldwide[4,]. Despite of availability of potent antibiotics the mortality rate due to acute bacterial meningitis remains significantly high in Morocco and other developing countries [5].

The incidence rates of the disease vary from one region to another by less than 2 cases per 100,000 inhabitants/year (France, Germany, Italy, Switzerland, Poland, the United States of America and China) to more than 10 annual cases/1,000 inhabitants, particularly in Africa[6], in neighboring Algeria, the incidence of meningitis in all forms varies from 1 year to another, from 16.66 in 2014 to 9.88 cases/100,000 inhabitants[7]. in 2015 (14, 98)

In Morocco, meningitis is one of the major public health problems caused by contagious diseases. They are endemic-sporadic with the emergence from time to time of epidemic micro-foci of meningococcal and viral meningitis. The epidemiological profile is dominated by meningococcal meningitis, the incidence of which is generally stable at around 3/100,000 inhabitants[8].

Between 2012 and 2017, the total number of cases of meningitis in all forms was 7290, of which 4796 were considered meningococcal. The case-fatality rate varied by region in Morocco, according to age group and pathogen with a national average[9] of 11.9%.

This lethality is particularly high among the most vulnerable groups, including children <5 years of age, in whom acute meningitis accounted for 2.7% of deaths in 2014, compared to 0.2% in the general population[10].

Aseptic meningitis is an acute community-acquired syndrome with cerebrospinal fluid (CSF) pleocytosis in the absence of a positive Gram stain and culture, without a parameningeal focus or a systemic illness and with a good clinical outcome[11].

The clinical syndrome has since been further characterized and understood to include multiple types of infectious and non-infectious etiologies one thing to note is that this is an unprecedented study in the region (North West of Morocco). It is useful to carry out this work with the purpose of describing the profile epidemiological, cytochemical and bacteriological profile of this disease. The purpose was also to determine the ability of various parameters commonly used for the diagnosis of acute meningitis bacterial and viral meningitis in adult and children patients in the North West region of Morocco.

MATERIALS AND METHODS

Population study: This is a retrospective study with a descriptive and predictive purpose with a purely quantitative approach. The target population involved all recorded meningitis patients of different ages and reported by the provincial unit: Epidemiology of the Health Systems Networks Service (SRES) of the Kenitra delegation during the last 5 years (2014-2018).

Methods: A survey was conducted on patients, the study protocol covers the following points: Identity of each patient (code number, age, sex) and geographical origin.

Including all patients admitted to the emergency unit with acute meningitis and a negative direct CSF examination.

Diagnoses inclusion criteria were clinical symptoms and signs of meningitis (e.g., fever, severe headache, severe irritability, photophobia, vomiting drowsiness, neck stiffness, bulging fontanel,) Either a positive culture from CSF or a negative culture with a positive CSF leukocyte concentration (WB) of >10 mm^{-3}, blood culture positive with CSF WBC of >100 mm^{-3}.

Data collected from cases, after getting and informed consent. The severity of meningitis in our patients was assessed according to the WHO meningitis prognostic scoring[12].

Statistical analysis: The data was analysed using statistical package for social sciences (SPSS) version 20 software. Variables were summarized using frequencies and percentages for categorical variables, median and range for continuous variables. The Chi-square test/Fisher's exact test was used for statistical analysis. A p-value of <0.05 was considered statistically significant.

RESULTS

Epidemiological profile: Between 2014 and 2018, 247 cases of acute community meningitis are reported by Kenitra Provincial Epidemiology Cell.

Morbidity and temporal distribution: The average cumulative incidence of all forms of meningitis in Kenitra during the study period is 4.53 (100,000 Hts). Indeed, the incidence decreased from 4.72 (100,000 Hts) in 2014 to 3.21 (100,000 Hts) in 2016, then increased to 6.25 (100,000 Hts) in 2018, while the average cumulative incidence of meningococcal meningitis during the study period is 2.96 (100,000 Hts) (Table 1).

According to the place of residence, the cases were distributed between 53.0% of urban origin, 47.0% of rural origin.

The most endemic commune was Sidi Boubker El Haj with an average annual incidence of 8.8/100000 Hts and the least endemic were the communes of Mehdia, Sidi Mohamed Ben Mansour, Oued El Makhazine and Beni Malek which recorded an average incidence of 0/100000 Hts (Fig. 1).

Table 1: Incidence of meningitis cases by years

Classification	2014	2015	2016	2017	2018	Mean
Cumulative incidence in all forms (100.000 Hts)	4.72	4.47	3.21	3.98	6.25	4.53
Incidence cumulative meningococcal meningitis (100.000 Hts)	3.59	2.79	2.11	2.53	3.75	2.96

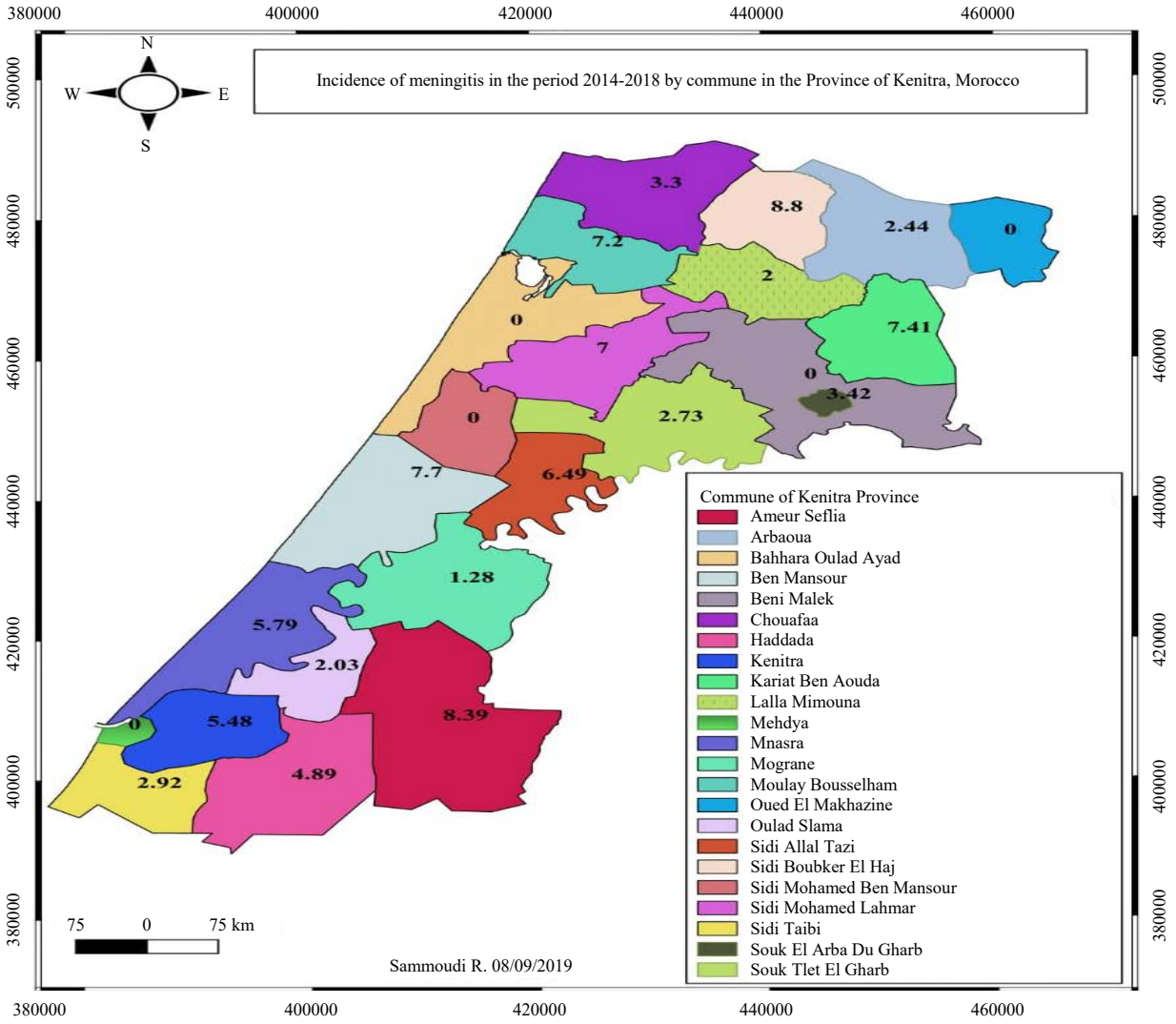

Fig. 1: Distribution of average annual incidence of meningitis by commune in the Kenitra Province between 2014 and 2018

Clinical features: In all cases, the predominant clinical signs were fever (96.4%), vomiting (78.9%) and headache in 82.6% of patient's case. The disorders of conscience (alteration of conscience and coma) were respectively present at (21.5%) and (8.9%) of the cases, the purpura and the convulsions were present at the admission respectively at (13.0%) and (10.1%) cases (Table 2).

Cytochemistry of cerebrospinal fluid (CSF) and bacteriology: The mean values of the different cytochemical parameters associated with the standard error of the mean (SEM) are presented in Table 3. All the parameters did not indicate significant differences between girls and boys ($p>0.05$).

The study included 247 patients with confirmed meningitis. Viral meningitis represented one third of cases 81 (32.8%) and acute bacterial meningitis represented the two thirds of cases 166 (67.2%). Thirty (18%) of the ABM cases were by MMC, 101 (60.8%) by MBP, 29 (17.5%) by MMP and 6 (1.7%) by pneumococcal meningitis. Both lymphocytic meningitis and probable bacterial meningitis prevailed among urbans (51.8 vs. 42.6%), males (69.1 vs. 63.4%). Forty four (54.3%) of lymphocytic meningitis cases were under 15 years and 51 (50.5%) of probable bacterial meningitis cases under 15 years (Table 4).

Therapeutic and evolutionary aspects: The mean time from onset of illness to admission was 7.23±14.56 days. Treatment is suspected of a case of meningitis in the emergency department, children under 15 years are referred to the pediatric ward and adults are referred to the Department of Medicine, or the Resuscitation Department of Al Idrissi Hospital according to the severity of the cases.

The length of stay was significantly different between the survivors and the deceased ($p<0.001$). Thus, for the survivors, the average duration was 10.6 days (+4.5 days). For the deceased, the duration was much shorter with an average of 5, 8 days (+4.3 days).

The highest case-fatality rate is recorded for probable meningococcal meningitis 31.0%, while the lowest mortality rate is recorded for lymphocytic meningitis (4 deaths), with an average mortality of 4.9% (Table 5).

The case mortality rate has varied over time, particularly in 2014 and in 2016 during which the highest mortality rate was recorded with 16.00 and 17.14%, respectively. In 2018, mortality decreased to 12.86% in 2018 (Fig. 2).

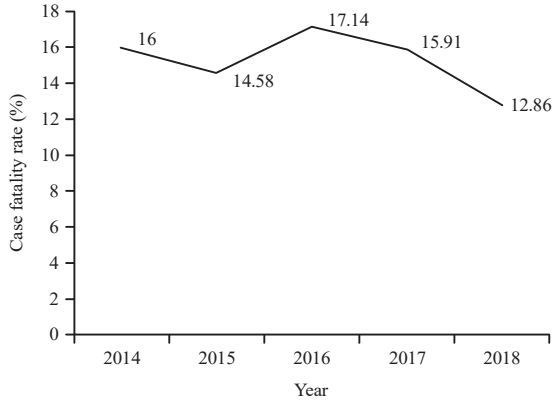

Fig. 2: Evolution of case-fatality rate of meningitis in the Kenitra Province between 2014 and 2018

Table 2: Clinical finding of cases of meningitis

Clinical	Clinical signs (%)
High fever	96.4
Vomiting	78.9
Convulsions	10.1
Coma	8.9
Purpura	13.0
Alteration of conscience	21.5
Headache	82.6

Table 3: Mean values (±standard deviation) of biochemical cerebrospinal fluid parameters

Parameters	Leucocyte count mm^{-3} (Mean±SEM)	Neutrophil (%) (Mean±SEM)	Lymphocyte (%) (Mean±SEM)	Protein (g L^{-1}) (Mean±SEM)	Glucose (g L^{-1}) (Mean±SEM)
Age (years)					
<15	1118.96±2273.47	57.70±34.47	42.29±34.47	1.33±1.62	0.47±0.24
15-40	1213.54±2156.06	54.04±34.55	45.87±34.44	1.52±1.11	0.45±0.24
>40	657.83±1286.55	62.11±32.71	37.88±32.71	2.05±2.51	0.53±0.40
Sex					
Male	959.95±2012.20	54.19±34.91	45.77±34.86	1.47±1.78	0.49±0.26
Female	1273.91±2284.17	62.86±32.32	37.13±32.32	1.55±1.51	0.45±0.30
Residence					
Urban	1113.47±1943.23	57.81±35.84	42.14±35.79	1.67±1.90	0.47±0.28
Rural	1030.82±2298.64	56.82±32.40	43.17±32.40	1.31±1.38	0.48±0.27
χ^2	0.072	0.122	-0.122	0.024	-0.066
p	0.279	0.063	0.064	0.714	0.321

SEM: Standard error of mean, statistically different for p-value<0.05

Table 4: Epidemiologic features of studied cases (n = 247)

	Viral meningitis (VM) n = 81 (32.8%)		Bacterial meningitis (BM) n = 166 (72.2%)									
	LYM		MBP (n = 101) (60.8)		MMC (n = 30) (18%)		MMP (n = 29) (17.5%)		PM (n = 6) (1.7%)			
Parameters	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Age (years)												
<15	44	54.3	51	50.5	19	63.3	22	75.9	03	50.0	139	56.3
15-40	27	33.3	29	28.7	08	26.7	04	13.8	01	16.7	69	27.9
>40	10	12.3	21	20.8	03	10.0	03	10.3	02	33.3	39	15.8
Sex												
Male	56	69.1	64	63.4	17	56.7	16	55.2	03	50.0	156	63.2
Female	25	30.9	37	36.6	13	43.3	13	44.8	03	50.0	91	36.8
Residence												
Urban	42	51.8	43	42.6	24	80.0	19	65.5	03	50.0	131	53.0
Rural	39	48.1	58	57.4	06	20.0	10	34.5	03	50.0	116	47.0
Seasonality												
Fall	12	14.8	26	25.7	09	30.0	03	10.3	02	33.3	52	21.1
Winter	11	13.6	21	20.8	09	30.0	10	34.5	02	33.3	53	21.5
Spring	32	39.5	20	19.8	02	06.7	09	31.0	01	16.7	64	25.9
Summer	26	32.1	34	33.7	10	33.3	07	24.1	01	16.7	78	31.6

LYM: Lymphocytic meningitis, MBP: Probable bacterial meningitis, MMC: Confirmed meningococcal disease, MMP: Meningococcal meningitis, PM: Pneumococcal meningitis

Table 5: Outcome according to the etiological agent of AS and ABM

	Total		LYM		MBP		MMC		MMP		PM			
Outcome	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	χ^2	p-value
Death	37	15	04	4.9	19	17.8	05	16.7	09	31.0	1	16.7	13.0	0.0113*
Cure	210	85	77	95.1	88	82.2	25	83.3	20	69.0	5	83.3		

*p<0.05 significantly level, LYM: Lymphocytic meningitis, MBP: Probable bacterial meningitis, MMC: Confirmed meningococcal disease, MMP: Meningococcal meningitis, PM: Pneumococcal meningitis

DISCUSSION

In this study conducted in Kenitra Provincial Epidemiology Cell for the last 5 years 2014-2018, the number of reported meningitis was 247, the mean age of patients being 18.53 years±18.72, although it occurs at any age, the most affected age groups are children and adolescents, especially children under 15 years (56.3%), these results coincide with the previous work[10,13,14]. The predominance of the male sex is recorded 63.20% against 36.80% of the female cases. The overall sex ratio of meningitis is 1.71, in fact the studies conducted do not fall under significant relationship between sex and prognosis of the disease, which joins the results of our study, On the other hand 47.00% of patients come from rural areas while 53.00% are from the urban area[14-16].

Between 2014 and 2018, cases of meningitis recorded in Kenitra province were clearly dominated by bacterial origin (67.2%), although data from the literature still report viruses as the most common cause of acute meningitis[9,10,13].

The average incidence of all forms of meningitis in our 2014-2018 study is 4.53/100,000 Hts, while meningococcal meningitis rank first among purulent meningitis, its incidence 3.01/100000 Hts, as well as data from our The study shows a morbidity that far exceeds the average national incidence between 2006 and 2014 of meningitis in all forms, including all ages[10] which was 2.72/100,000 Hts.

The comparison of our results with those of other studies[17] revealed the same classic clinical symptom of meningitis (headache, nausea or vomiting, fever, altered mental state, stiff neck and/or signs of meningeal irritation) appear in less than half of all adult patients and are much less specific in children, elderly individuals[18]. Immunocompromised patients, diabetic patients and other patients with chronic diseases[19].

Therefore, the sensitivity and specificity of these signs and symptoms are not optimal for distinguishing between possible BM and viral meningitis (VM)[19]. This may lead to delays in the administration of an appropriate antibiotic treatment[20].

Acute bacterial meningitis appeared in the current study as an important type of meningitis, in accounted for approximately two thirds of cases. Similar finding has been reported bay others[21]. In this study, the main two causative bacteria were *S. pneumonaie* and *N. meningitidis*. Nonetheless a considerable percentage was attributed to other undetermined bacteria which may be klebsiella pneumoniae and enterobacteria and others as shown by Farag in Alexandria[22]. However, in India, a low incidence of infection with *N. meningitidis* has been reported[23].

In addition, one of the most important findings in the epidemiology of meningitis in North West Morocco is the number of Cases of Haemophilus Meningitis influenzae experienced a remarkable regression in 2008 and 2009 reflecting the first positive effects of the introduction of anti-Hib vaccination in the calendar of the National Immunization Program, starting[5] in January, 2007.

The case-mortality rate remains variable from 1 year to another, according to age group and pathogen with an average of 14.9% during the 2014-2018 study periods. The low case mortality rate of lymphocytic meningitis (4.9%) can be explained by the fact that almost all are of viral origin, that the rise in the lethality rate of pneumococcal meningitis is often reported in studies[10]. However, according to the Ministry of Health, this rate remains higher than the national average of 11.9% between[8,24] 2012-2017. Finally, the present study has allowed us to know the epidemiology of this disease in the Province of Kenitra. A pre-hospital case management approach for severe cases and cases with a high risk of death, based on clinical data and CSF analysis, generally makes it possible to direct treatment

CONCLUSION

The causes of acute meningitis are many and varied. A pre-hospital case management approach for severe cases and cases with a high risk of death, based on clinical data and CSF analysis, generally makes it possible to direct treatment. It is important to emphasize the absolute urgency of purulent bacterial meningitis, which can be fatal, especially since treatment is delayed.

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SIGNIFICANCE STATEMENT

This study found bacterial meningitis and viral meningitis are a real health problem especially in children and Acute bacterial meningitis is a serious disease resulting in neurological complications. This study adds describe the profile epidemiological, cytochemical and bacteriological aspects of infectious meningitis.

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