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Epidemiological and Evolutionary Profile of Bacterial Meningitis in Children Under 12 Years of Age in the Kenitra Region, Morocco

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Abstract **Introduction:** Bacterial meningitis in children, constitutes a serious public health problem in Morocco. The aim of this work was to describe the epidemiological, bacteriological and evolutionary profile of bacterial meningitis in patients admitted to the Cherif Idrissi Hospital of kenitra. **Methods:** This is a retrospective study of children with meningitis with an average age of less than 5.55±0.25 years (minimum= 1 year and less; maximum= 12 years), from 2010 to 2018. **Results:** We collected 200 cases. The median age was 6 years, with a male predominance. The main germs isolated were Neisseria meningitidis (25%) and Streptococcus pneumoniae (33.5%). The case fatality rate was estimated at 8%. **Conclusion:** The results of our study have confirmed the important lethality of meningitis. Therefore, the health authorities must organize diagnosis and treatment campaigns especially in the environment at risk and make sure to carry out epidemiological studies around each case, and chemoprophylaxis for contacts, in order to reduce the mortality rate related to this pathology, without forgetting the fight against meningitis in an endemic country like ours.

Keywords Epidemiology, Bacterial Meningitis, Neisseria Meningitides, Streptococcus Pneumonia, Kenitra Hospital, Morocco

1. Introduction

Meningitis is an infection of the meninges, most often of bacterial, viral, fungal or parasitic origin. It is considered a public health emergency due to its high case fatality rate and its grave health, economic and social consequences [1, 2].

Meningitis affects all ages, but the risk in children is greater [3, 4]. Bacterial meningitis is of particular concern. Approximately 1 in 10 people with this type of meningitis die and 1 in 5 develop serious complications [5]. In recent years, the introduction of vaccines against the bacteria involved in meningitis (Haemophilus influenzae b, pneumococcal conjugate vaccine), providing long-lasting protection, is the most effective way to reduce the burden and mitigate the consequences of meningitis [6, 7]. In 2020, the World Health Assembly supported by WHO have established the global roadmap "Defeating meningitis by 2030". In 2019, these bacteria were responsible for more than 50% of the 250,000 deaths from meningitis (WHO, 28 September 2021). Outside of epidemics, haemophilus influenzae is the most common agent of meningitis in

children under 5 years of age (20-40%). Pneumococcus predominates in infants and the elderly (15-30%). Meningococcus (20-50%) affects all ages but especially young adults. Other bacterial agents account for only 20-30% of isolation [8-10]. Several risk factors contribute to the meningitis epidemic, such as climatic, environmental, dietary, socioeconomic and genetic factors [11].

In Morocco, meningitis, especially meningococcal meningitis, is a serious public health problem. A National Program for the Control of this disease was established in 1989. A retrospective study conducted by the National Meningitis Observatory between 2012 and 2018 showed 365 cases of confirmed bacterial meningitis whose most identified germs are Meningococcus and Pneumococcus in patients with an average age of 3.7 years.

The objective of this work is to describe the epidemiological situation of meningitis in the region of Kenitra from 2010 to 2018, as well as the evolutionary status of patients.

2. Research Methodology

2.1. Study Type and Subjects

Retrospective cohort study was conducted at the regional hospital of kenitra. The study included meningitis cases of age less than or equal to 60 months who were hospitalized in the services of the ́Hospital, between 2010 and 2018.

2.2. Data Collection

The variables collected from the medical record were:

*Age, sex;

*Duration of hospitalization in days: difference between the date of entry and the date of discharge;

*Location of urban or rural residence;

*Location of the municipality of residence;

*Type of meningitis;

*Disposition of the patients: cured or not cured.

2.3. Statistical Analysis

The data were entered and analyzed on SPSS version Essaie. Quantitative variables were expressed as mean ± standard deviation, or median. Qualitative variables were expressed as relative frequency. Joint analyses used: χ^2 test. First-species risk was set at 5%.

*Lethality rate. The ratio between the number of deaths due to a disease and the number of people with that disease.

*The morbidity rate is the number of people affected by a given disease in a given population during a given period.

3. Results

3.1. Sociodemographic Characteristics

200 cases of meningitis of children (less than 12 years old) were collected during the study period (2010 to 2018) at idrissi hospital of kenitra (HIK), of which 62.5% (n=125) were male and 37.5% (n=75) were female. The sex ratio was not balanced ($p<0.000$), with a male predominance. The mean age of the patients was 5.55 ±0.25 years (minimum= 1 year and less; maximum= 12 years), with a median of 6 years. The coefficient of variation expressed as a percentage shows a large dispersion in each group that exceeds 60% heterogeneity.

3.2. Hospitalization Characteristics

The patients reported by the HIK services belonged to more than 20 communes that make up the provinces of Kenitra. 85.5% (n=171) of the cases were seen and admitted directly to HIK; 9.50% (n=19) were referred to the HER (Rabat Children's Hospital) and 5% (n=10) of these sick children were hospitalized in other hospital structures before being transferred to HIK.

The average length of stay in hospital services was 9.24 ±0.435 days, with a minimum of 0 days and a maximum of 40 days. The median was 9 days and the coefficient of variation was 55.55%. However, 86% of the sick children were hospitalized for more than 4 days and 14% were hospitalized for less than 4 days. Table 1 presents the results of the chi-square test of independence between the length of hospitalization (LH) and the variables (sex, hospital, place of residence; age). Moreover, a significant association was found between LH and sex (Khi2=3.59; $p<0.05$). In fact, 80% (60/75) of females and 89.6% of males (112/125) were hospitalized for more than 4 days. However, there was a strong association between DH and hospital service (Khi2=65.52; $p<0.000$). Indeed, 92.28% of the patients admitted to the HIK were hospitalized for more than 4 days, whereas 15 patients among 18 referred to the HER were hospitalized for more than 4 days. However, all patients hospitalized in other health services were referred immediately to the HIK. The Khi-square test also showed a significant association between LD and residence setting ($p<0.042$). 90.65% of patients from urban origin and 80.64% from rural origin were hospitalized for more than 4 days. However, there was no significant association between LD and age ($p<0.38$).

3.3. Evolution

In our study and among the 200 cases of children with meningitis, we noted a cure rate of 61% (n=122) and we deplored 16 deaths, i.e. a case fatality rate of 8%. However, there was no indication on the evolution of the health status of 62 children. The Khi-square test did not show any significant difference between the evolution and the variables (sex, age and place of residence), but the difference was highly significant between the evolution and the length of stay (Khi-square= 55.12; $p<0.000$). Moreover, 12 patients hospitalized for less than 4 days and 4 patients hospitalized for more than 4 days died with case

fatality rates of 42.85% and 2.32% respectively. We found that the longer the hospitalization time, the lower the case fatality and the higher the cure rate. However, there was a highly significant association between evolution and hospitalization (Khi2=17.85; p<0.001). Indeed, the case fatality rate of patients hospitalized at the HIK was 7.56 deaths (13/172) and 3 patients among 18 patients were referred to the HER died. The average age of the cured children was 5.79±0.31 years, while that of the deceased was 3.88±0.82 years (Table 2).

Table 1. Cross-tabulation between length of hospitalization and variables (gender, hospital, place of residence; age)

VARIABLE	MODALITY	< 4 DAYS	> 4 DAYS	TOTAL	KHI2 (P-VALUE)
SEX	F	15	60	75	**3,59* (p<0,05)**
	M	13	112	125	
TOTAL		28	172	200	
HOSPITAL	HIK	15	157	172	**65,52*** (p<0,000)**
	HER	3	15	18	
	Other service	10	0	10	
TOTAL		28	172	200	
AREAS	Urban	10	97	107	**4,14* (p<0,042)**
	Rural	18	75	93	
TOTAL		28	172	200	
AGE	<5ans	10	97	107	**0,76 (p<0,38)**
	>5ans	18	75	93	
Total		28	172	200	

*: significant difference at 5%; ***: very highly significant difference

HIK: idrissi hospital of kenitra; HER: Rabat Children's Hospital

Table 2. Cross-tabulation between evolution and variables (gender, place of residence, length of hospitalization, age and facility)

VARIABLE	MODALITY	EVOLUTION			TOTAL	KHI2 (PVALUE)
		CURED	DEATHS	NO FOLLOW-UP		
GENDER	F	44	9	22	75	**2.61 (p<0.27)**
	M	78	7	40	125	
TOTAL		122	16	62	200	
LOCATION OF RESIDENCE	URBAN	69	8	30	107	**1.19 (p<0.55)**
	RURAL	53	8	32	93	
TOTAL		122	16	62	200	
LENGTH OF HOSPITALIZATION	< 4 DAYS	8	12	8	28	**55.12*** (p<0.000)**
	> 4 DAYS	114	4	54	172	
TOTAL		122	16	62	200	
AGE	<5 YEARS	57	11	31	99	**2.75 (p<0.25)**
	>5 YEARS	65	5	31	101	
TOTAL		122	16	62	200	
STRUCTURE OF RECEPTION	HIK	114	13	45	172	**17.86** (p<0.001)**
	HER	5	3	10	18	
	OTHER SERVICE	3	0	7	10	
Total		122	16	62	200	

*: Significant difference at 5%; ***: Very highly significant difference

HIK: idrissi hospital of kenit; HER: Rabat Children's Hospital

Table 3. Cross-tabulation between the type of meningitis and the variables (gender, place of residence, facility; duration of hospitalization, evolution; duration of hospitalization and age)

Variable	Modality	Meningococcal meningitis	Lymphocytic meningitis	Pneumococcal meningitis	Total	Khi2 (p-value)
GENDER	F	22	23	20	65	2.8 (p<0.24)
	M	28	33	47	108	
TOTAL		50	56	67	173	
LOCATION OF RESIDENCE	Urbain	33	36	25	94	12.8** (p<0.002)
	Rural	17	20	42	79	
TOTAL		50	56	67	173	
STRUCTURE OF RECEPTION	HIK	40	50	59	149	4.68 (p<0.32)
	HER	6	5	3	14	
	Other service	4	1	5	10	
TOTAL		50	56	67	173	
EVOLUTION	Cured	29	36	41	106	4.32 (p<0.36)
	Deaths	6	1	5	12	
	No follow-up	15	19	21	55	
TOTAL		50	56	67	173	
LENGTH OF STAY IN HOSPITAL	< 4 Days	11	1	9	21	10.29** (p<0.006)
	> 4 Days	39	55	58	152	
TOTAL		50	56	67	173	
AGE	<5 years	32	30	31	93	3.62 (p<0.163)
	>5 years	18	26	36	80	
Total		50	56	67	173	

*: Significant difference at 5%; ***: Very highly significant difference

HIK: idrissi hospital of kenitra; HER: Rabat Children's Hospital.

Type of Germs

Three types of meningitis were identified in our sample such as Meningococcal meningitis (25%), Pneumococcal meningitis (33.5%) and Lymphocytic meningitis (28%). However, 13.5% of germs were not identified. Only the factors of place of residence and length of hospitalization were significantly associated with the type of meningitis respectively (Khi2=12.8; p<0.002) and (Khi2=10.29; p<0.006). On the other hand, 53.16% of rural patients had pneumococcal meningitis; 25.32% had lymphocytic meningitis and 21.51% had meningococcal meningitis. However, 38.16% of the patients who stayed more than 4 days developed pneumococcal meningitis and 36.18% had lymphocytic meningitis (Table 3).

4. Discussion

According to the literature review, bacterial origin meningitis continues to pose a significant global health issue, with bacterial species responsible for acute cases varying based on factors such as age, geographical location, duration of hospitalization, and vaccination status [12].

On the epidemiological front, reported mortality rates in recent studies exhibit some regional variations. For example, a study conducted in Morocco showed an incidence rate ranging from 2 to 3.6 cases per 100,000 inhabitants [13], with a mortality rate between 10% and 12% [14]. It's important to note that these rates are dynamic and can change over time due to various factors, including advancements in healthcare, vaccination strategies, and antibiotic resistance patterns.

In our study, the overall fatality rate of bacterial meningitis in children under 12 years of age hospitalized during the period 2010-2018 was 8%. This value remains significantly below the threshold described by the WHO (>20%), which could indicate issues in case management and suggest a need for treatment revision. According to a study conducted in the Tanger - Tetouan - Al hoceima region in Morocco, the average fatality rate was 11.79% [15].

In terms of bacterial structure, streptococci, especially Streptococcus pneumoniae, meningococci predominantly Neisseria meningitidis, and lymphocytic meningitis, also

known as "curable acute meningitis" or "Armstrong's disease," remain the most dreaded bacterial agents associated with the disease. According to our study, the most feared bacteria were streptococci (33.5%), mainly represented by Streptococcus pneumoniae; meningococci (25%), primarily dominated by Neisseria meningitidis; and lymphocytic meningitis (28%), also known as "curable acute meningitis" or "Armstrong's disease" [16].

A study conducted in New Zealand over a 29-year period from 1991 to 2020 found 5142 hospitalizations (63% male) due to aseptic meningitis. Unspecified viral meningitis was the most frequently coded cause, accounting for 64% (3294/5142) of hospitalizations. Enterovirus was the most common specified cause, accounting for 29% (1497/5142) of hospitalizations. The number of cases caused by herpes simplex virus, mumps, varicella-zoster virus, and lymphocytic choriomeningitis virus was lower [17]. In comparison with our study, we noted that 33% of children were affected by lymphocytic meningitis.

In relation to gender susceptibility to the disease, our study noted that males are more affected by the infection with a significant correlation (P-value < 0.005) [18]. These findings are consistent with other studies. These previous studies have shown that males and the age group between 1 month and 2 years remain predominant. This is consistent with other French and Tunisian studies that emphasize the predominance of infants and males. Similarly, in 2010, 31 prognostic studies on factors related to sequelae or deaths from bacterial meningitis described males as a functional prognostic factor [19,20,21,22].

5. Conclusions

In conclusion, our study has unveiled valuable insights into the prevalence of three distinct types of meningitis: meningococcal, pneumococcal, and lymphocytic. These findings underscore the complex interplay between meningitis type, place of residence, and the length of hospitalization, emphasizing the multifaceted nature of disease outcomes.

This research contributes to the scientific understanding of meningitis epidemiology and its broader implications. It highlights the need for targeted interventions that consider not only the specific type of meningitis but also the geographic factors and the duration of hospital care. These insights have the potential to improve patient care and public health strategies.

Furthermore, our study opens up avenues for future research, particularly in the context of vaccination coverage and vaccine efficacy. Investigating the relationship between different types of meningitis and vaccination rates can inform policies aimed at enhancing protection against these infections, ultimately contributing to the prevention of meningitis-related morbidity and mortality.

From an economic perspective, the findings of our research may have significant implications. Understanding the distribution and determinants of meningitis types can guide resource allocation in healthcare systems, potentially reducing the economic burden associated with treating meningitis cases. Additionally, the insights into vaccination coverage can inform cost-effective vaccination strategies that maximize public health benefits.

In summary, this study not only advances our knowledge of meningitis but also holds promise for improving healthcare practices and policies, with potential economic benefits. Further research in this direction can lead to more effective prevention and management of meningitis, ultimately benefiting both individuals and society as a whole.

REFERENCES

[1] K, H., Gonzalez, F., & Kondamudi, N. (2022, August 14). Meningitis. Retrieved from National Library of Medicine: https://www.ncbi.nlm.nih.gov/books/NBK459360/

[2] Blanco, B. P., Priscila C.A.A., B., Cristina R.M., Y., & Angela E., F. (2020). Pediatric bacterial meningitis and meningococcal disease profile in a Brazilian General Hospital. The Brazilian Journal of Infectious Diseases, 337–342.

[3] Luksic I, Mulic R, Falconer R, Orban M, Sidhu S, Rudan I. Estimating global and regional morbidity from acute bacterial meningitis in children: Assessment of the evidence. Croat Med J. 2013; 54(6):510-8.

[4] Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, et al. Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. Lancet. 2012;379:2151-61.

[5] WHO. Defeating Meningitis by 2030: A Global Roadmap. June 24, 2021.

[6] Adams WG, Deaver KA, Cochi SL, et al. Decline of childhood Haemophilus influenzae type b (Hib) disease in the Hib vaccine era. JAMA 1993; 269:221-6.

[7] Bingen E, Levy C, de la Rocque F, et al. Bacterial meningitis in children: a French prospective study. Clin Infect Dis 2005; 41:1059-63.

[8] Matthijs C. Brouwer, Allan R. Tunkel, Diederik van de Beek. Epidemiology, Diagnosis, and Antimicrobial Treatment of Acute Bacterial Meningitis. Clinical Microbiology Reviews, July 2010; 467–492.

[9] E. Varon. Epidemiology of acute bacterial meningitis in adult patients in France. Médecine et maladies infectieuses. 2009;39:432–444.

[10] 17th Consensus Conference on Anti-Infective Therapy. Management of acute community-acquired bacterial meningitis (excluding newborns), SPILF. Réanimation. 2009; 18:353—365.

[11] Gary D. Indications for the Immunological Evaluation of Patients with Meningitis. Clinical Infectious Diseases, 2003; 36(2):189–194. doi: 10.1086/345527.

[12] Epidemiology of bacterial meningitis in Lebanon from 2011 to 2019 Antonio El Kareh et al.

[13] MERABET M. Epidemiological profile and prognostic factors of acute community-acquired bacterial meningitis in children under 5 years in the Tanger - Tétouan - Al hoceima region, 2006 - 2015. 2017, p: 48.

[14] Borrow R, Caugant DA, Ceyhan M, Christensen H, Dinleyici EC, et al. Meningococcal disease in the Middle East and Africa: Results and updates from the Global Meningococcal Initiative. J Infect. 2017;75: 1–11. doi:10.1016/j.jinf.2017.04.007.

[15] Sasan M S, Alborzi A, Ziyaeyan M. Epidemiology of Aseptic Meningitis in Infants and Children (Shiraz - Iran). Arch Clin Infect Dis. 2012;7 (4): 116-8. https://doi.org/10.5812/archcid.15086.

[16] McBride, M., Williman, J., Best, E., Walls, T., Sadarangani, M., Grant, C. C., & Martin, N. G. (2022). The epidemiology of aseptic meningitis in New Zealand children from 1991 to 2020. Journal of Paediatrics and Child Health, Early View. https://doi.org/10.1111/jpc.16131.

[17] C. Levy. Taha MK. Bingen E. Cohen R. et al. Pediatric meningococcal meningitis in France: ACTIV/GPIP network results. 2012; 3.19: 49-54. https://doi.org/10.1016/S0929-693X(12)71273-3.

[18] Levy C, Varon E, Taha MK, Béchet S, Bonacorsi S, Cohen R et al. Evolution of childhood bacterial meningitis in France due to vaccination. Arch Pédiatrie 2014; 21: 736–744.

[19] Thabet F., Tilouche S., Tabarki B., Amri F., Guediche MN., M.T. Sfar, M. Harbi, A. Yacoub M., Essoussi AS. Mortality from pneumococcal meningitis in children. Prognostic factors in a series of 73 cases. Archives de Pédiatrie. 2007;14:334-337. https://doi.org/10.1016/j.arcped.2006.11.012.

[20] Gary D. Overturf. Indications for the Immunological Evaluation of Patients with Meningitis. Clinical Infectious Diseases, 2003; 36 (2):189–194. doi: 10.1086/345527.

[21] Brouwer MC, Tunkel AR, van de Beek D. Epidemiology, diagnosis, and antimicrobial treatment of acute bacterial meningitis. Clin Microbiol Rev. 2010; 23 (3):467-92.