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Impact of Covid-19 pandemic on pediatric meningitis incidence in central Morocco

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ABSTRACT

Bacterial meningitis is a diagnostic, therapeutic, and prophylactic emergency, particularly for children. In Morocco, meningitis remains a major public health challenge with lethality between 10% and 12% of cases. Our objective is to determine the impact of COVID-19 pandemic on the incidence of pediatric meningitis in central Morocco. A retrospective epidemiological study was carried out in the Department of Pediatric Emergencies of the Mother and Child Hospital of Marrakech in Morocco. Data were collected from patient files of Meningitis cases reported during the confinement period in March, April, and May of 2019 and 2020 respectively. Then, data were analyzed using SPSS software. The results showed a notification of 72 cases of suspected meningitis between March 2019 and March 2020 with dominance of boys (up to 70%) and age range of 1 month to 2 years (up to 34%). We noted a decrease in the number of patients hospitalized for suspected meningitis during COVID-19 pandemic. The final diagnosis of suspected meningitis was confirmed for 20% of the cases during the containment period against only 2.38% before the pandemic. This difference was statistically significant ($P<0.05$). Our investigations confirm the effect of the COVID-19 pandemic on the incidence of bacterial meningitis of children in the study area, more investigations are needed to generalize and explain these results in Morocco.

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Introduction

Bacterial meningitis in children is a diagnostic and therapeutic emergency [1,2] due to its high lethality and severe sequelae [3]. Despite advances in prevention and management, bacterial meningitis persists worldwide, particularly in developing countries [4,5].

In Morocco, meningitis remains a public health problem with a case fatality rate between 10% and 12% in 2012 [2]. The world continues to battle the COVID-19 pandemic which officially started in China. It has progressively invaded all continents and almost all countries in the world [6]. Faced with this pandemic, the Moroccan government applied total containment in

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the country with the declaration of a general state of emergency from March 16th to May 20th, 2020. The purpose of this containment was to control the spread of the virus, to avoid saturation of health services and ensure their sustainability, and to protect the public health system from a disastrous collapse [7]. Morocco, like other countries, has tried to manage the situation in an uncertain climate because of the limited knowledge of Coronavirus pathology by giving it priority over other public health priorities [8].

Although Morocco's containment was successful in controlling the spread of the COVID-19 pandemic, it effectively impacted other communicable diseases. In the fight against COVID-19, it is critical to know what other diseases are competing with the coronavirus to better manage resources in our health care facilities. Synergies between virus and bacteria have, in fact, already been observed with influenza A, since during the influenza pandemic of 1918–1919, a large number of cases of meningococcal meningitis were described following the initial viral infection [9]. Studies have shown the presence of an association between meningitis and influenza that measures the impact on airborne agents reduces both influenza and meningitis transmissions and thus reduces the incidence of invasive meningococcal disease (IMD) [9]. This result was observed a century ago when the 3-foot bed distance in military barracks reduced the risk of infectious meningitis (IM) epidemics in recruits [10]. Similarly, sepsis has been observed as a frequent complication during COVID-19 [11]. Knowing that anti-complementary drugs (c5) used against COVID-19 are known to increase the risk of IMD [12,13]. Little data is available on the association between SARS-CoV-2 and secondary bacterial infections. The present study aims to explore the impact of COVID-19 pandemic on the incidence of major pediatric emergencies, such as meningitis, in central Morocco.

Materials and methods

Study type and setting

This is a retrospective study, based on the exploitation of the records of patients hospitalized at the level of the Pediatric emergency department of the Mother and Child Hospital, CHU Mohammed VI of Marrakech.

The pediatric emergency department (PED) of the Mother and Child Hospital at the Mohammed VI University Hospital is considered the only specialty service in the southern region of Morocco that can care for children requiring tertiary level care. During this pandemic, the Marrakech-Safi region was one of the five regions in Morocco most affected by COVID-19 [14].

The preparation of health facilities is a key element of the response to the pandemic of COVID-19. In the pediatric emergency room at the Mother and Child Hospital of the Marrakech University Hospital, it was reorganized as follows: (a) canceling pediatric consultations, (b) separating the circuits of non-COVID patients from COVID patients.

Data collection and ethical considerations

Using a pre-established survey form, data regarding admissions to the SUP inpatient unit for suspected meningitis between the period of March, April, May, and June of the year 2019 and March, April, May, and June of the year 2020 (containment period), were extracted from patient records.

The variables targeted were: the sociodemographic profile, clinical and paraclinical status, treatments, and final diagnosis.

We have divided the final diagnosis in our study into 3 categories:

- Suspected meningitis: when the clinical signs are in favor of meningitis and the results of further examinations are insufficient to confirm the diagnosis.
- Rejected meningitis: when the clinical signs are in favor of meningitis and the results of complementary examinations invalidate the diagnosis
- Confirmed meningitis: when the clinical and paraclinical signs are in favor of meningitis.

In addition, we conducted a census of all suspected bacterial meningitis from the year 2015 to the year 2020.

The study was carried out after getting authorization of local and regional Health service (Reference N°2692/21). In addition, confidentiality and anonymity were respected during the data collection.

Data analysis

The data were analyzed using SPSS software (version 18). The Student's *t*-test for no paired samples with a significance level of $p = 0.05$ was used to answer the question: Is there a significant difference between the incidence of meningitis before and during confinement?

Results

After the elimination of incomplete records, a total of 72 records were retained for this study concerning children aged 0–16 years who were hospitalized in the emergency department of the Mother and Child Hospital for suspected meningitis: 42 records for the period before introduction of COVID-19 in Morocco and 30 records for the confinement period (during COVID-19 pandemic).

Table 1
Distribution of population study according to socio-demographic characteristics.

	Period before confinement March, April, May, June/2019		Period during confinement March, April, May, June/2020	
	N	%	N	%
Gender Male Female	30 12	71,43 28,57	18 12	60 40
Age range <1 month 1month to 2 years 2 to 6 years 6 to12 years More than 12 years	10 14 10 6 2	24,39 34,15 24,3914,63 2,44	9 10 3 6 2	30 33.34 10 20 6.66
Region Marrakech-Safi Draa-Tafilalt	41 1	97,61 2,39	28 2	93.33 6.67
Area Rural Urban	10 32	23,81 76,19	7 23	23.33 76.67
Total	42	100	30	100

Table 2
Treatments and final diagnosis of patients in the study.

Antibiotics Yes No	Before confinement		During confinement	
	42 0	100% 0%	26 4	86.67% 13.33%
Type of antibiotic Amoxilline+gentamicine Céphalosporine 3 Céphalosporine+gentamicine Céphalosporine 3+amoxilline Triaxon	2 29 10 1	4.76% 69.05% 23.81% 2.38%	19 5 2	73.08% 19.23% 7,96%
lumbar puncture (LP)	42	100%	30	100%
Aspect of spinal fluid Clair 35 Hematic disorder	3535 5 2	79,41% 14,71% 5,88%	16 8 6	44% 32% 33%
Results Confirmed Meningitis Rejected meningitis Suspected Meningitis	1 16 25	2,38% 38,10% 59,52%	6 13 11	20% 43.33% 36.67%
TOTAL	42	100%	30	100%

We noted for both samples (Table 1) before confinement (BC) and during confinement (DC), the predominance of male gender (71.43% /60%), the age range of 1 month to 2 years (34.15% /33.34%.), with origin almost exclusively from the Marrakech-Safi region (97.61% /93.33%).

The sex ratio Male/Female of the studied sample is 2.5 (BC) and 1.5 (DC) and the average age is 1283 days (DC) and 1070 days (BC).

According to Table 2, the appearance of the puncture showed the presence of blood for 14.71% (BC) and 32% (DC) and a cloudy appearance for 5.88% (BC) and 24% (DC).

The antibiotic was administered in the emergency room in the period before the confinement period for all patients against 86.67% of patients during confinement. An exclusive prescription of 3rd generation cephalosporin was administered to 69.05% of patients before the confinement period and 73.08% of patients during confinement (Table 2).

The final results according to the records showed that after review:

- before the containment period, 16 patients were reported as rejected meningitis with only one confirmed case of bacterial meningitis.
- during the containment period, 13 patients were reported as rejected meningitis and 6 cases of confirmed bacterial meningitis.

According to Fig. 1, we noted that during the six years (2015–2020), suspected meningitis is the most dominant diagnosis, and confirmed meningitis had a maximum rate during the year 2020.

Fig. 2 showed that emergency department visits dropped during the containment period.

A correlation test for paired samples between the period (BC and DC) and the final diagnosis shows a statistically significant difference between the incidence of meningitis before and during confinement ($P<0.05$). To obtain more results we opted for the Chi2 and Fisher test to evaluate the presence of a relationship that resulted significantly lower than 0.05. This showed a correlation between the confinement period and the incidence of meningitis.

Discussion

In our knowledge, it is the first study in Africa describing the incidence of meningitis as well as the frequency of pediatric emergency service visits according to the confinement.

The incidence of meningitis in the period before and during confinement following COVID-19 revealed that for both samples, the male gender and the age range between 1 month and 2 years remained predominant. This is consistent with other French and Tunisian studies that emphasize the predominance of infants and the male gender [15–17]. Similarly, in 2010, 31 prognostic studies on the factors of sequelae, or death, from bacterial meningitis described the male gender as a functional prognostic factor [18].

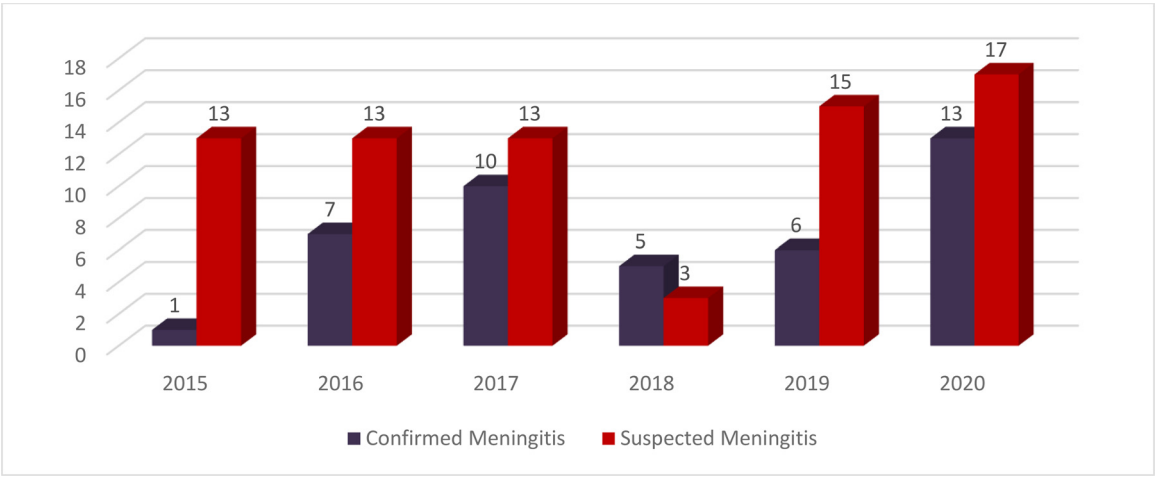

Fig. 1. Distribution of child bacterial meningitis cases registered in the emergency department between 2015 and 2020.

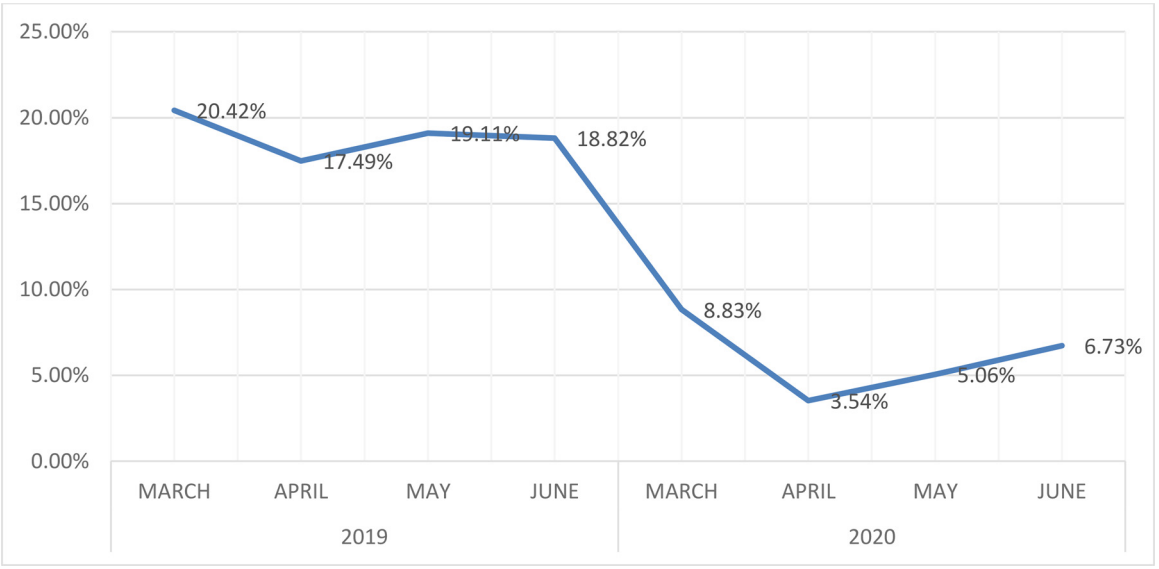

Fig. 2. Distribution of medical visits to pediatric emergencies Before and During COVID-19 pandemic in Morocco.

COVID-19 studies have shown that males are more prone to develop this disease, with the hypothesis that steroid hormones are important modulators of cellular immunity [19]. For children, the epidemiological transmission characteristics of COVID-19 in China revealed that, unlike adults, there is no difference between males and females [20]. This may be due to the lack of sexual maturation of children and adolescents, which is consistent with the study of Li et al. [21]. We can conclude that the epidemiological character of meningitis and COVID-19 is different because meningitis affects more young and male children, while the relationship between the gender and COVID-19 is not confirmed.

In the study area, meningitis cases are predominant in urban areas (97.61% BC; 93.33% DC). This can be explained by the health measures taken in Morocco since the declaration of the state of emergency in March 2020 [22]. These precautions have made it difficult to refer patients to health facilities, thus decreasing their use by parents. Additionally, the rate of hospitalizations in SUP decreased from 17.49% in April 2019 to 3.54% in April 2020. This result is consistent with other studies that have noted the decrease in the number of patients in different health care facilities [23]. It can be explained by the nature of the confinement period that modified the behavior of parents, therefore affecting the incidence of pediatric visits [24]. These policy measures have not only reduced the spread of COVID-19, but also other infectious diseases [25,26].

Antibiotics were administered in the emergency room during the period (BC) for all patients suspected of having meningitis, compared to 86.67% during the period (DC). The prescription of 3rd generation cephalosporin was exclusive for 69.05% of patients before the confinement period against 80.08% during confinement. According to the general rule, the initial antibiotic treatment of bacterial meningitis should be guided by direct CSF (cerebrospinal fluid) examination, or PCR (poly-

merase chain reaction) tests [27]. Most authorities in developed countries, as well as the meningitis guide in Morocco, recommend dual therapy with ceftriaxone (C3G) and vancomycin in all children over one month of age with probable or definite bacterial meningitis [28–30].

In our study, the predominance of the use of antibiotics before containment can be explained by the influence of the pandemic of COVID 19 and the interest in universal antibiotics to treat this epidemic that triggered a reluctance to administer antibiotics before obtaining a certain diagnosis to avoid unnecessary treatment.

The final results showed the absence of meningitis (rejected meningitis) in 16/42 patients (BC) versus 13/30 (DC) with only one confirmed case of bacterial meningitis before containment 1/42 versus 6/30 in the same period during containment. A high frequency of suspected cases of meningitis with rare confirmed cases is usually noted for the diagnosis of meningitis [31].

In the present study, the incidence of meningitis was 6 times more frequent during containment in the study area. This result is statistically significant ($P < 0.05$). Indeed, meningococcal epidemics were identified during the 2020 epidemic season (December-June) in the meningitis belt of sub-Saharan Africa; a meningococcal serogroup C (MenC) epidemic was identified in Benin, and a meningococcal serogroup X (MenX) epidemic in Ghana [32].

Moreover, very recent studies have investigated the impact of the COVID-19 pandemic on infectious diseases incidence, including meningitis, more than 26 countries, confirming these finding [33,34].

SARS-CoV-2 may have neuroinvasive potential through neurological symptoms such as headache, nausea, and vomiting [35]. Ling et al. [36] state that SARS-CoV-2 can infect the nervous system and skeletal muscles as well as the respiratory tract. In addition, autopsy results of COVID-19 patients showed that the brain tissue was hyperemic and edematous and some neurons were degenerated [37]. The neurological lesions were confirmed during infection with other CoV such as SARS-CoV and MERS-CoV. Thus, COVID 19 could have varieties of presentations that may include meningitis-like disease [38]. The association between secondary viral and bacterial infection was proven during the 1918 influenza A epidemic, including IMD [9,39].

The diagnosis of meningitis in Morocco is still insufficient due to the presence of an increasing number of false emergencies and suspicions of meningitis; hence the interest in developing in Morocco and Africa an universal and more rigorous protocol to better diagnose meningitis using new technologies available.

The African Union's Agenda 2063 places children at the center of concerns, hence the interest of offering them the right to health by emphasizing the environment and its influence on infectious diseases including meningitis.

Conclusion

The study was able to show a relationship between the incidence of bacterial meningitis in children and the COVID-19 pandemic in Morocco. This requires further study to confirm and explain these results. The strategies implemented to prevent the spread of COVID-19 offer a unique opportunity to evaluate the potential effects of these interventions on other infectious diseases, similar to our study, but the sample studied remains insufficient to confirm our result.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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