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Clinical and Bacteriological Profile of Infections in Sickle Cell Children in Two Referral Hospitals in Niamey, Niger

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Abstract

Introduction: Infections are significant causes of mortality in sickle cell children in resource-limited countries. This study aimed to determine the clinical profile and bacterial ecology of infections in children with sickle-cell disease in two referral hospitals in Niamey. **Patients and methods:** A retrospective descriptive study was conducted from January 2018 to July 2020 in two referral hospitals in Niamey. All children aged one (1) to 15 years with sickle cell disease admitted for suspected infection, including at least one bacterial culture, were studied. Bacteriological analysis was performed using the appropriate culture media, using BactAlert (Reference 4700003 BTA3D60 BioMérieux). **Results:** Over 36-months, 350 children with a mean age of 10.9 months were admitted. The sex ratio was 1.2. The SS electrophoretic profile was the most common (93.4%). Immunization status was up to date in 66% of patients. Fever was the common reason for consultation (55.1%). Infection was confirmed in 62 patients (17.7%). The primary diagnoses were bacterial gastroenteritis (24.2%) and urinary tract infection (19.4%). Blood cultures were isolated from *Salmonella typhi* (13.0%) and *Escherichia coli* (8.7%). *Klebsiella spp* (7.1%) and *Escherichia coli* (5.0%) were detected in cytobacteriological examination of urine. *Salmonella typhi* (23.5%) and *Escherichia coli* (5.9%) were isolated on coproculture. **Conclusion:** Bacterial ecology appears not different from that usually observed in sickle-cell children. *Salmo-*

nella and *Escherichia coli* were predominant.

Keywords

Sickle Cell Disease, Child, Infection, Niger

1. Introduction

Sickle cell disease is a cosmopolitan genetic disorder [1] [2]. In Africa, 500,000 children are born with the disease, and 60% to 80% die before age of five years due to a lack of early detection and adequate treatment [3]. Infections frequently punctuate the course of the disease, and are life-threatening for children, especially in resource-limited countries [1]. Their highest incidence is observed in the first years of life, and their frequency decreases with age, but the risk persists throughout life. Meningitis and septicemia are the most serious infections in children [3]. A better understanding of the mapping of infections encountered should enable us to improve management and envisage more appropriate preventive measures. This study aimed to determine the clinical profile and the ecology of bacteria found in infections among sickle-cell children admitted to two referral hospitals in Niamey.

2. Patients and Methods

2.1. Type, Period and Study Setting

A retrospective descriptive study was conducted from January 2018 to July 2020 (36 months) in the pediatric wards of Niamey National Hospital and Amirou Boubacar Diallo National Hospital, two referral hospitals in Niamey.

2.2. Study Population and Variables

All sickle-cell children (SS or SC electrophoretic profile) aged between one (1) to 15 years admitted to the corresponding departments for suspicion of bacterial infection were included. All usable records containing at least one bacterial culture (urine, stool or blood) were studied. Children's socio-demographic characteristics, clinical signs and culture results were the studied variables.

2.3. Sampling Technique and Analysis Methods

Urine was collected per micturition on the first micturition in a sterile jar in the morning. Stools were also collected aseptically in a sterile jar fitted with a sampling spatula. Blood cultures were taken in the event of a febrile peak (≥38.5˚C) or hypothermia (≤36.5˚C) in culture media. All samples were taken in hospital, and then transported to the laboratory in no more than one hour for processing. Lumbar puncture was performed if patients had neurological signs. Bacteriological analysis was carried out using the appropriate culture media, using BactAlert (Reference 4700003 BTA3D60 BioMérieux).

2.4. Data Collection, Source and Statistical Analysis

A data extraction sheet was used to collect information from patients' hospitalization records, and from the biology laboratory's registers. Data were entered and analyzed using Epi-Info7 version 7.2.1 software. Results were expressed as numbers and percentages for children's variables and bacteriological data.

2.5. Ethical Aspects

The study was approved by the Faculty of Health Sciences of Abdou Moumouni University of Niamey, and the management of both hospitals. Anonymity and medical confidentiality were respected.

3. Results

3.1. Characteristics of Children

Over 36 months, 350 children with sickle cell disease were admitted for suspected bacterial infection. Table 1 shows Children characteristics. The mean age was 10.9 months [6 months-14 years]. The sex ratio was 1.2. The SS electrophoretic profile was the most common (93.4%). Classical Expanded Program of Immunization (EPI) vaccination status (diphtheria, tetanus, pertussis, poliomyelitis, yellow fever, measles and pneumococcus) was up to date in 66% of patients. None had received vaccines outside the EPI. Fever was the most frequent reason for consultation (55.1%), followed by pallor (52.1%). C-reactive protein (more than 6 $mg.L^{-1}$ was positive in 84.4% of cases, and hyperleukocytosis, defined as a white blood cell count above 20.000 cells/μL, was found in 96.4%. The diagnosis of infection was confirmed in 62 patients (17.7%). The most frequent diagnoses (Table 2) were bacterial gastroenteritis (24.2%), urinary tract infection (19.4%), pneumonia (19.4%) and acute osteomyelitis (9.7%).

3.2. Bacteriological Profile

Bacteriological results are shown in Table 3. Blood cultures were taken from 46 children, with 28.3% of positivity. The main germs isolated were *Salmonella* typhi (13.0%) and *Escherichia coli* (8.7%). Urine cytobacteriological examination (UCBE) was carried out in 99 patients, with 12.1% of positive results. *Klebsiella* spp (7.1%) and *Escherichia coli* (5.0%) were found. Fifty-one (51) coprocultures were requested, with 29.4% positive results. *Salmonella* typhi (23.5%) and *Escherichia coli* (5.9%) were isolated. Cytobacteriological examination of cerebrospinal fluid revealed one (1) case of *Streptococcus pneumoniae*. Ceftriaxone combined with gentamicin was used in 96.3% in the treatment. Progression was favorable in the majority of patients (99.4%). One (1) death resulting from complications of anemia was observed.

4. Discussion

Management of bacterial infections in sickle cell children should be based on probabilistic antibiotic therapy, considering to avoid progression to severe sepsis

[1] [2]. Based on the observations of this study, the bacterial ecology in our context was similar to that usually reported in the literature. The limitations of this work were mainly related to the almost systematic prescription of antibiotics in hospitalized sickle cell patients, which probably increased the low culture positivity rate. In all cases, the incidence and severity of infections, and the context of limited resources, justify this therapeutic attitude.

Table 1. Characteristics of children.

Variables	Effective	Percent
Sex		
Male	165	47.1
Female	135	52.9
Age range		
6 - 11	91	26
12 - 59	170	48.6
60	89	25.4
Electrophoretic profile		
SS	327	93.4
SC	23	6.6
EPI* status		
Up to date	231	66
Not up to date	119	34
Clinical signs		
Fever	194	55.1
Mucocutaneous pallor	193	52.1
Osteoarticular pain	129	36.8
Diarrhea/Vomiting	53	15.1
Abdominal pain	50	14.2
Cough	45	12.9
Hand-foot syndrome	29	8.4
Respiratory distress	14	4
Other	14	4

Table 2. Diagnoses.

Diagnose	Effective	Percent
Bacterial gastroenteritis	15	24.2
Pneumonia	12	19.4
Urinary tract infection	12	19.4
Acute osteomyelitis	6	9.7
Septicemia	6	9.7
Others	11	17.6
Total	**62**	**100**

Table 3. Isolated germs.

Type of culture/Germ	Effective	Percent
Blood culture		
Salmonella typhi	6	13.0
Escherichia coli	4	8.7
Staphylococcus aureus	3	6.5
Sterile	33	71.8
UCBE*		
Klebsiella spp	7	7.1
Escherichia coli	5	5.0
Sterile	87	87.9
Coproculture		
Salmonella typhi	12	23.5
Escherichia coli	3	5.9
Sterile	36	70.6
Cerebro-Spinal Fluid culture		
Streptococcus pneumoniae	1	10
Sterile	10	90

*UCBE: Urine cytobacteriological examination.

4.1. Characteristics of Children

The predominance of children under five years of age in this series has been reported by Diakité *et al.* [4] in Mali and Latoundji *et al.* [5] in Benin. Generally, the high susceptibility of sickle-cell patients to infection is well known, and the risk of infection is greatest in younger children, particularly infants [1] [2]. In addition to the physiological immaturity of the immune system in this age group, functional asplenia associated with abnormalities in immunoglobulins, leukocyte function and cell-mediated immunity could further weaken the means of infectious control in these children [6] [7].

4.2. Bacteriology

Knowledge of the local bacterial ecology is essential for effective antibiotic prophylaxis and vaccination prevention programs. In this study, *Salmonella* typhi and *Escherichia coli* dominated the bacteriological profile. In the series by Douamba e*t al.* in Burkina Faso, *Streptococcus pneumoniae* (35.5%) and *Salmonella* spp (33.3%) were more frequently reported [8]. The predominance of *Streptococcus pneumoniae* found by these authors can be explained by the fact that brocho-pneumonia being the most frequent diagnosis. Indeed, pneumonia in children with sickle cell disease is essentially due to *Streptococcus pneumoniae* [7] [9] [10] [11] [12]. The relatively high EPI vaccination coverage in our context, considers this bacterium, and the systematic antibiotic prophylaxis with oral penicil-

lin in all sickle-cell children, could explain the low proportion of pneumococcal infections observed. Generally, invasive pneumococcal infections have been a major cause of morbidity and mortality in sickle cell patients, especially in precarious living conditions. These infections are often brutal and severe, making curative treatments often ineffective [13]. While preventive antibiotic therapy with penicillotherapy has proved effective, vaccination remains the principal means of control [14]. *Salmonella* typhi, found in coprocultures in this study, is more likely to be implicated in osteoarticular infections [15]. According to the authors, this could be explained by their high susceptibility to osteoarticular infections. What's more, these infections are endemic in the context of poor living conditions [3]. However, effective prevention through vaccination has been available for many years. This should be offered systematically to all children with a tare, generally from the age of two for the polysaccharide vaccine, and six months for the conjugate vaccine [16]. Other studies have also reported the predominance of *Escherichia coli* and *Klebsiella* spp in urinary tract infections. The perineum is highly colonized by enterobacteria of digestive origin, in particular *Escherichia coli*. In addition, this bacterium possesses specific uropathogenicity factors, thus favoring these infections [17] [18].

5. Conclusion

Bacterial ecology appears not different from that usually observed in sickle-cell children. *Salmonella* typhi and *Escherichia coli* predominate, mainly responsible for urinary tract and gastrointestinal infections. Prophylaxis must therefore take these results into account, particularly about *Salmonella*. Indeed, an immunization program should be set up for sickle cell children. It would also be necessary to strengthen diagnostic resources to enable a more complete mapping of pathogens, and to adapt preventive measures.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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