Archives of Pediatrics
CISSE L, et al. Arch Pediatr 8: 278
www.doi.org/10.29011/2575-825X.100278
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Research Article

Insights into Bacterial Ecology and Management of Community-Acquired Infections in Pediatric Surgery: A Prospective Study in a Developing Country

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Citation: CISSE L, Balla LO F, MBAYE PA, NDOYE NA, GUEYE D, et al. (2023) Insights into Bacterial Ecology and Management of Community-Acquired Infections in Pediatric Surgery: A Prospective Study in a Developing Country. Arch Pediatr 8: 278. DOI: 10.29011/2575-825X.100278

Received Date: 21 June 2023; **Accepted Date:** 14 July 2023; **Published Date:** 18 July 2023.

Abstract

Objective: The aim of our study is to investigate the bacterial ecology of community-acquired infections in the pediatric surgery department of Albert Royer Children's Hospital, and evaluate the medical and surgical management practices. **Methods:** Between January 10, 2019, and July 10, 2019 a prospective descriptive study was conducted involving patients aged 0 to 15 years hospitalized for community-acquired infections Various parameters were analyzed. **Results:** During the study period, 89 patients were admitted for the management of infections, accounting for 15.8% of all hospitalized patients. Infants constituted the majority (32.6%), with a male predominance (sex ratio = 2.7). Sickle cell disease was present in 7.9% of patients. Additionally, 25 patients (28%) were underweight, and 15 cases of consanguinity (16.9%) were identified. Osteoarticular infections were the most prevalent (38%), with Staphylococcus aureus being the predominant organism. We isolated three multi-resistant enterobacteria, two of which were associated with urinary tract infections and one with osteoarticular infections. First-line β-lactam antibiotics were administered to all patients, with antibiotic therapy adjustment necessary in 4.1% of cases. Surgical intervention was performed in 80% of patients. The average hospital stay was 10.6 days, ranging from 1 to 45 days. The study reported a morbidity rate of 3.4% and a mortality rate of 2.2%, with two deaths recorded. **Conclusion:** Community-acquired infections predominantly affect male infants and are often characterized by osteoarticular infections, primarily caused by Staphylococcus aureus. Our study sheds light on the emergence of multi-resistant community-acquired enterobacteria and their significant prevalence in urinary tract infections.

Keywords: Infection; Infant; Boy; Multi-resistant Enterobacteria; Surgery; Albert Royer Children's Hospital

Introduction

The advent of antibiotics and vaccines has significantly altered the prognosis of infections in children. However, infections continue to prevail in our daily lives. The pediatric population, despite sharing some risk factors for infections with adults, exhibits unique characteristics. Immune system immaturity in children contributes to rapid disease progression, increased bacterial dissemination, frequent secondary localizations, and slower resolution of infectious processes, particularly in newborns and infants [1]. Consequently, infections in children are associated with higher morbidity and mortality rates, with reported mortality rates ranging from 3% to 23% in the literature [2].

Moreover, these infections have far-reaching implications for public health, including parental work absenteeism. However, there is a scarcity of epidemiological data specifically focused on infections in pediatric surgery. It is within this context that our study was conducted, with the primary objective of investigating the bacterial ecology of community-acquired infections across various infectious sites within the pediatric surgery department at Albert Royer Children's Hospital. Additionally, we aimed to assess the medical and surgical management practices employed in these cases.

Material and Methods

This study was conducted as a prospective cross-sectional investigation. The study population included all patients between the ages of 0 and 15 years who were hospitalized in the aforementioned pediatric surgery department for the management of a community-acquired infection during the period from January 10, 2019, to July 10, 2019. Patients who received outpatient management for their infections were excluded from the study.

Various parameters pertaining to each patient were collected and analyzed, including the reason for admission, patient characteristics, diagnostic tools employed, bacterial ecology, treatment modalities, and clinical outcomes. Data collection was performed through patient interviews and thorough examination of medical records, with the information recorded using a standardized survey form. Data entry and subsequent analysis were conducted using Sphynx software and Microsoft Office 2010 (Word and Excel).

Results

Epidemiology

During the study period, a total of 89 patients were hospitalized for the management of community-acquired infections, accounting for 15.8% of all hospitalized patients. The average age at the time of the initial consultation was 5 years, ranging from 0 days to 15 years. Infants comprised the largest proportion, representing 32.6% of the study population (Table 1). Of the patients, 65 were boys and 24 were girls, resulting in a sex ratio of 2.7. Sickle cell disease was identified as the only comorbidity in 7 patients (7.9%). Additionally, 25 patients (28%) were classified as underweight, with 22 of them severely underweight. Consanguinity was noted in 15 cases, accounting for 16.9% of the patients.

Class	Count	Percentage
0 days-28 days	7	6,7%
29 days -30months	36	34,6%
30 months -4years	12	11,5%
5 years -9 years	28	27%
10 years -15 years	21	20,2%
Total	104	100%

Table 1: Patient distribution by age.

Diagnostic Management

Four types of community-acquired infections were identified in the study. Among the patients, thirty-five individuals presented with osteoarticular infections. The majority of these cases (62%) were attributed to septic arthritis, followed by osteomyelitis (35%), and osteoarthritis (3%). Regarding ecology, Staphylococcus aureus was detected in 10 patients, Enterobacter sp in 1 patient, and Mycobacterium tuberculosis in 1 patient. A single multi-resistant enterobacteria strain, exhibiting resistance to β-lactams except carbapenems, was also detected.

Soft tissue infections (STI) were observed in 26 patients, with myositis accounting for 88.5% of these cases. The other STI were 1 abcess, 2 phlegmon, 2 necrotizing dermo-hypodermatitis. Staphylococcus aureus was identified in 10 patient and Escherichia coli in 1 patient.

In relation to uro-genital infections, six patients were diagnosed with pyelonephritis, and five of them had an associated malformative uropathy: two cases of posterior urethral valves, two

cases of pyeloureteral junction syndrome, and one case of a double urinary system with ureterocele. Another patient had urethral stenosis resulting from a previous trauma. Additionally, two cases of genital infections were documented: one involving pyocolpos with vaginal aplasia, and the other an ovarian abscess. Regarding the bacterial ecology, three patients were found to have E. coli infections, three had K. pneumoniae infections, and two cases of Enterobacter sp, which were multi-resistant to β-lactams except carbapenems, were also identified.

Appendicular pathologies represented 65% of intra-abdominal infections (IAIs). (Table 2) lists the intra-abdominal infections. Non-fermenting gram-negative bacteria, Group C Streptococcus, Salmonella sp, E. coli, P. aeruginosa, and Pneumococcus decapitate were the isolated pathogens in IAIs.

Type	Pathology	Count
Uncomplicated intra-abdominal infection	Acute appendicitis	8
	Appendicular abscess	3
	Liver abscess	2
	Enterocolitis in Hirschsprung's disease	1
	Infected choledochal cyst	1
Complicated intra-abdominal infection	Appendicular peritonitis	6
	Post-operative stercoral peritonitis	1
	Primary peritonitis	1

Table 2: Distribution of intra-abdominal infections.

Therapeutic Management

All hospitalized patients in the department received empiric antibiotic therapy, with β-lactams prescribed in 53% of cases, aminoglycosides in 36%, and nitroimidazole in 11%. Treatment adaptation was necessary in 4.5% of patients who underwent antibiogram testing. Surgical intervention was performed in 80.9% of patients. The average duration of hospitalization was 10.6 days, ranging from 1 to 45 days.

Morbidity and Mortality

Morbidity was observed in three patients, accounting for 2.9% of the study population. The complications identified were as follows: persistent suppuration after debridement for myositis, persistent pyocolpos following drainage for pyocolpos on vaginal aplasia, and a limp and leg length inequality resulting from arthrotomy for hip arthritis. Two deaths were recorded, accounting for 2.3% of the patients. These fatalities were attributed to bilateral pyonephrosis complicated by acute renal failure and rectus and vastus lateralis thigh myositis.

Discussion

Infections are a significant concern in pediatric surgery, accounting for nearly one-sixth of the patients hospitalized in our department during the study period. While infections can occur at any age, neonates and infants are particularly vulnerable due to their immature immune systems [1]. In our study, infants represented over a third of the patients, highlighting their susceptibility to infections.

Osteoarticular infections were the most prevalent in our study. Advancements in pharmacology and a better understanding of healthcare-associated infections (HAIs) in children have resulted in a significant reduction in the prevalence and mortality of these infections [3]. However, the incidence of osteoarticular infections remains higher in developing countries [4]. In our study, the incidence of osteomyelitis was 6.2%, compared to 1% in Thomsen's study in general pediatrics [5]. Staphylococcus aureus was the most common pathogen, consistent with the literature [4]. We have not noted any deaths in patients with HAI, an event that has become rare in the management of these infections [4]. However, morbidity remains high and often affects the growth of the affected limb [4]. In our study a patient presented with lower limb length inequality following hip arthritis.

Soft tissue infections are also frequent in pediatrics and accounted for a substantial portion of the patients in our study [6]. Staphylococcus aureus remains the primary causative organism globally, and our findings support this [7]. Treatment for soft tissue infections involves drainage of purulent collections and targeted antibiotic therapy against Staphylococcus aureus [7]. In our study, all patients received this treatment, and the majority had a favorable outcome. However, there was one case of morbidity due to insufficient drainage, requiring repeat surgery, and one postoperative death in an infant operated on for myositis.

Intra-abdominal infections (IAIs) are a common cause of community-acquired infections, but the lack of standardized classification makes comparison between studies challenging [8]. They are dominated by complicated AII in low and middle-income countries [8]. Appendicular pathologies, especially complicated appendicitis, were the most frequent source of IAIs in our study. Concerning the ecology of intra-abdominal infections, the germs are very varied depending on the organ of origin affected [10]. Thus, we have not found any preponderant germs in intra-abdominal infections. Surgical treatment, combined with probabilistic antibiotic therapy, is essential for controlling IAI. In our study, all microorganisms identified were sensitive to β-lactams, and no adaptation of the first-line probabilistic treatment was necessary.

In our study, Gram-negative bacteria (GNB) were the main microorganisms responsible for UTIs, with E. coli and K. pneumoniae being the most common. These results are in accordance with the literature [11, 13], which is due to the particular structure of GNB that facilitates their attachment to uroepithelial cells. GNB are often resistant to amoxicillin and ampicillin, in nearly 46% of cases [12]. This explains why some teams do not use these antibiotics for probabilistic antibiotherapy in pediatric UTIs [12]. This was the case in our study, where all patients received a prescription of third-generation cephalosporins as first-line treatment. They reserve the use of this antibiotic for patients with severe UTIs [14]. Morbidity and mortality from UTIs are still high in children [15-19].

Urinary tract infections (UTIs) are prevalent in pediatrics, but they represented a smaller proportion of hospitalized patients in our department during the study period [11]. This is because our department primarily focuses on patients with UTIs associated with malformative uropathy or acquired urinary tract pathology. Early treatment of UTIs is crucial for reducing long-term morbidity and mortality rates [12]. In our study, Gram-negative bacteria (GNB), particularly E. coli and K. pneumoniae, were the main pathogens responsible for UTIs, aligning with the literature [11, 13]. These GNB often exhibit resistance to amoxicillin and ampicillin, necessitating the use of third-generation cephalosporins as the first-line treatment, treatment we used in our study. However, it should be noted that in some countries, the amoxicillin-clavulanic acid combination is used as first-line treatment [14]. Indeed, according to these teams, the emergence of extended-spectrum beta-lactamases (ESBLs) in community-acquired UTIs is mainly due to the overuse of third-generation cephalosporins and antibiotic prophylaxis [14-16]. The highest prevalences in the community are observed in low-income countries [17]. A review by Woerther et al. estimated community carriage of ESBLs at 70%, 35%, and 15% in Asia, the Eastern Mediterranean Basin, and Africa, respectively [18]. It's important to note that morbidity and mortality rates associated with UTIs remain high in children, underscoring the significance of effective management and treatment strategies.

Conclusion

In conclusion, our study highlights the significant burden of community-acquired infections, particularly osteoarticular infections, in male infants. While the overall morbidity and mortality rates were relatively low, the presence of community-acquired ESBL-producing enterobacteria, especially in urinary tract infections, raises concerns about the overuse of broad-spectrum antibiotics. It is crucial to improve technical platforms and enhance access to diagnostic tools in our region, promote antimicrobial stewardship programs and raise awareness among healthcare providers regarding the rational use of antibiotics. By implementing these measures, we can ensure the effective management of community-acquired infections while minimizing the risk of antibiotic resistance and its associated consequences.

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