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Epidemiological and Bacteriological Profiles of Urinary Tract infections at the Medical Biology Laboratory of Sikasso Hospital (Mali)

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Abstract

The objective of this work was to describe the epidemiological and bacteriological aspects of urinary tract infection in Sikasso hospital. This descriptive prospective cross-sectional study took place from February to August 2022 in the laboratory of Sikasso hospital. The identification of the bacteria was made from cultural, biochemical (Api 20E gallery) and antigenic characters. Antibiotic resistance was performed using the disc technique in agar medium and interpretation was made according to the recommendations of the antibiogram committee of the French microbiology society. We practiced 448 uine cytobacteriological examinations of which 61 met the urinary tract infection criteria, ie a prevalence of 13.64%. Gram-negative bacteria accounted for 98.36% of isolates with a predominance of *E. coli* 75.40%, followed by *Klebsiella pneumonia* 18.03%. The age group 60 and over in males was the most affected with 64.86% (p: 0.0001) of cases. A significant relationship was found for age (p: 0.0001), gender (p: 0.04) and the urinary tract infection. Concerning sensitivity to antibiotics *E. coli* opposed a resistance of 92.50% to aminopenicillins, 82.93% to cotrimoxazole, 76.09% to 3rd generation cephalosporins and 65.22% to ciprofloxacin. The resistance mechanism by extended-spectrum betalactamase production was observed in 47.83% of *E. coli* strains. At the end of this study, the hospital prevalence of urinary tract infection is estimated at 13.64% with *Escherichia coli* and *Klebsiella pneumoniae* as the majority microorganisms.

Keywords: Epidemiology; bacteriology; urinary tract infection; Sikasso; Mali

Introduction

Urinary tract infection (UTI) is the aggression of a tissue of the urinary tree by one or more microorganisms generating an inflammatory response and symptoms of variable nature and intensitys [1]. They are one of the most frequent infections, both in community medicine and in hospitals, and occupy an important place in the reasons for consultation [2]. Their prevalence increases with age in women, while in men their frequency increases after 50 years, in connection with prostate pathology [3]. In Mali, the prevalence of SU is estimated at 18.5% by a study carried out in 2019 in a hospital in Bamako [4]. The germs most often involved are gram-negative bacilli, natural hosts of the intestine and the environment [5]. Knowledge of the epidemiological and bacteriological profile of these infections is essential for efficient management, as well as monitoring the antibiotic susceptibility of the bacteria responsible [3]. This is why we are addressing this problem, the objective of which was to describe the epidemiological and bacteriological aspects of UTIs at the Sikasso hospital.

Materials and Methods

This prospective cross-sectional study with a scriptive aim that took place from February to August 2022 at the medical biology laboratory of the Sikasso hospital. This hospital has a hospital capacity of more than 198 beds and has several specialties. All patients admitted to the laboratory for urine cytobacteriological examination (ECBU) during the study period were included. The urine came from inpatients or outpatient consultants. Each urine was subjected to a routine ECBU comprising the following elements (i) a uroculture with germ count (bacteriuria) on Uriselect agar 4 (ii) a direct examination to assess leukocyturia and figurative elements of urine (red blood cells, crystals, cylinders . . .). The identification of bacteria was made on the basis of cultural, biochemical (galleries Api 20E, catalase, oxidase, coagulas) and antigenic (streptococcal agglutination, etc.). Antibiotic sensitivity was carried out according to the technique of diffusion of discs in agar medium and interpretation was made according to the recommendations of the Antibiogram Committee of the French Society of Microbiology [6]. The detection of extended-spectrum beta lactamase (ESBL) was made by the synergy test between a central disc of amoxicillin + clavulanic acid distant 30 mm from the discs of cefotaxime, ceftazidime, cefepime and aztreonam. Study variables were: age, sex, hospitalization, uropathogenic bacteria, antibiotic susceptibility. EPI INFO software version 7.2.1. 0 was used for statistical analysis of data.

Ethical considerations

The informed consent of each patient was obtained prior to inclusion in the study and anonymity and confidentiality of the data were preserved.

Results

We performed 4,48 ECBUs, of which 61 met the criteria for I-TU for a prevalence of 13.62%. The majority of UTIs were confirmed in outpatient patients 85.25% (52/61). Males made up 60.66% (37/61) and females 39.34% (24/61). Gram-negative bacteria (BGN) accounted for 98.36% of isolates with *E. coli* predominance (75.40%), followed by *Klebsiella pneumoniae* (18.03%) (Table 1). The age group 60 years and older in mascul sex was the most affected with 64.86% (p: 0.0001) of cases. The probability of ACU was twice as high in females (risk: 0.18) than in males (risk: 0.11). A significant relationship was found for age (Odds ratio: 2.83; p: 0.0001), sex (Odds ratio: 0.55; p: 0.02) and ITU (Table 2). Regarding antibiotic susceptibility *E. coli* opposed a resistance of 92.50% to aminope-nicillins, 93.48% to amoxicilline + clavulanic acid, 82.93% to cotrimoxazole, 76.0 9% to cephalos porins of 3rd generation and 65.22% to ciprofloxacin. Nevertheless, nitrofurantoin, fosfomycin and gentamycin retained their efficacy with 93.48%, 92.31% and 59.10% respectively (Table 3). The mechanism of resistance by ESBL production was identified in 47.83% (22/46) of *E. coli* strains. ESBL profiles in these *E coli* strains were associated with resistance to gentamycin in 45%, ciprofloxacin in 77.27% and cotrimoxazole in 78.95%. These ESBL-producing *E colis* were sensitive to nitrofurantoin (95.45%) and Fosfomycin (92.31%) (Table 4). *Klebsiella pneumoniae* isolates were susceptible to ciprofloxacin (63.64%) and gentamycin (54.71%) (Table 3).

Germs	***Staff***	***Frequency (%)***
Escherichia coli	46	75,40
Klebsiella pneumoniae	11	18,03
Proteus mirabilis	2	3,27
Enterobacter cloacae	1	1,64
Enterococcus spp.	1	1,64
Total	61	100,00

spp: any species; ***UTI***: urinary tract infection.

Table 1: Bacteria involved in UTIs.

Variables	***Odds ratio***	***IC 95 % OR***		***p***	***Prevalence (%)***
		Lower	***Upper***		
Age groups	2,83	1,63	4,91	0,0001	
< 60 years (n= 27)					6,02
Over 60 years (n= 34)					7,60
Sex	0,55	0,31	0,97	0,02	
Female (n=24)					5,38
Male (n=37)					8,25
Hospitalization	1,85	0,84	4,10	0,07	
Yes (n=9)					2,01
No (n=52)					11,61

OR: Odds ratio; 95% ***CI***: 95% confidence interval; ***P***: P-Value.

Table 2: Factors associated with the ITU.

Antibiotics	***Escherichia coli***		***Klebsiella pneumoniae***	
	S (%)	***R (%)***	***S (%)***	***R (%)***
Amoxicillin	3(7,50)	37(92,50)	-	RN
Amoxicillin+ Clavulanic Acid	3(6,52)	43(93,48)	2(18,18)	9(81,82)
C3G	11(23,91)	35(76,09)	4(36,36)	7(71,43)
Gentamycine	26(59,10)	18(40,90)	6(54,55)	5(45,45)
Ciprofloxacin	16(34,78)	30(65,22)	7(63,64)	4(36,36)
Fosfomycine	36(92,31)	3(7,69)	1(14,29)	6(85,71)
Nitrofurantoine	43(93,48)	3(6,52)	5(50,00)	5(50,00)
Cotrimoxazole	7(17,07)	34(82,93)	1(14,29)	6(85,71)

S: sensitivable; ***R***: resistant; ***RN***: natural resistance; ***C3G***: third generation cephalosporin

Table 3: Antibiotic susceptibility of *E. coli* and *Klebsiella pneumoniae* strains.

Antibiotics	***Escherichia coli BLSE***	
	Sensible (%)	***Resistant (%)***
Gentamycine	11(55,00)	9(45,00)
Ciprofloxacin	5(22,72)	17(77,27)
Fosfomycine	17(89,47)	2(10,53)
Nitrofurantoine	21(95,45)	1(4,55)
Cotrimoxazole	4(21,05)	15(78,95)

ESBL: Extended-spectrum betalactamase.

Table 4: Antibiotic susceptibility of ESBL Escherichia coli strains

Study limitations

We did not use Mueller Hinton Cloxacillin Agar to study the susceptibility of bacterial strains to cephalosporins.

Discussion

ITU is a well-known pathology both in urban medicine and in hospital practice [7]. Our prevalence of UTI, which is 13.63%, is lower than that found by Hailaji et al. in Algeria (1 8.4 %) [8], kalambry et al. in Mali (18.5 %) [4] and similar to that of Sbiti et al. in Morocco (13.3%) [9]. The majority of the ITU was confirmed among Community countries (85.25%). This rate is much higher than that reported by Benhiba et al. in 2015 (47%) [1] and comparable to that of Garba et al. in Niger (88.82%) [10]. This situation is justified by the fact that IT Uis one of the most frequent community-acquired bacterial infections [8]. Gram-negative bacilli accounted for 98.36% of all germs isolated, led by *E. coli* (75.40%). This observation is shared by other authors with variable rates. The ascending pathophysiology of IT U as well as the strong colonization of the perineum by enterobacteria of digestive origin, associed to specific factors of uropathogenicity such as bacterial adhesives capable of binding to the urinary epithelium could explain this predominance [2, 8, 11]. In our study the probability of UTIs was higher in females (risk: 0.18) than in males (risk: 0.11). The same observation has been made by several authors in the literature, this being due to specific contributing factors (short urethra, pregnancy, proximity of the urinary tract to the anus) [2, 4, 12, 13]. Men over 60 were the most affected by the ITU with 64.86%. This could be explained by incomplete emptying of the bladder and discomfort to the urine drainvery common at these ages associated with a decrease in the defenses of the urinary tree. Our study confirmed significant resistance of *E. coli* to aminopenicillins (92.50%). This observation is consistent with the results of some African authors: Rakotovao-Ravahatra in Madagascar obtained 94.1% of strains resistant to amoxicillin [13], for Kalambry 92.30 % of *E. coli* strains are resistant to amoxicillin [4]. This high rate of resistance can be explained by the misuse of this antibiotic in our health facilities but also by self-medication [2]. Nitrofurantoin and Fosfomycin maintained good activity, reaching 93.48% and 92.31% respectively. These results are superimposed on those reported by El Bouamri et al. (93% nitrofurantoin-sensitive *E coli* strains and 89% Fosfomycin) [11]. *E coli* strains showed significant resistance to third-generation cephalosporins (76.0-9%) and ciprofloxacin (65.22%). These resistance rates are higher than those observed by Hailaji et al. in 2016 [8]. These levels of resistance achieved are worrying and alarming. This situation is the consequence of selection pressure due to the massive prescription and often abusive use of broad-spectrum antibiotics (beta-lactams, fluoroquinolones, etc.) both in hospitals and in the community [2]. The rate of resistance of *E. coli* to cotrimoxazole was 82.93%, significantly higher than that reported in France (19.7%) [7]. This molecule is to be avoided in the first line by our practitioners because its resistance rate is quite high. The mechanism of antibiotic resistance through ESBL production was identified in 47.83% of *E coli* strains. This proportion is lower than that of Toudji et al. (57.94%) in Togo in 2017 [15]; higher thanthat reported in Mali by Kalambry et al. in 2019 (14.28%) [4]. This could be explained by the high secretion of ESBLs by uropathogenic *E. coli* strains and their wide diffusion in both community and hospital settings [11]. ESBL *E. coli* profiles were associated in 77.27% with resistance to ciprofloxacin, in 45.00% with gentamycin and in 78.95% with cotrimoxazole. El Bouamri et al. in Morocco found an association with ciprofloxacin (82%), gentamycin (66%) and cotrimoxazole (76%) [11]. The excessive use of these antibiotics in human health could lead to selection pressure, hence the emergence of these resistances and multirestrance [16].

In this study *Klebsiella pneumoniae* maintained a highsensitivity to ciprofloxacin (63.64%) and gentamycin (54.71%). These levels are lower than those reported by hadji et al. (ciprofloxacin (66.4%); gentamycin (80.5%) [8].

Conclusion

At the end of this study, the prevalence of urinary tract infection is estimated at 13.64%, with Escherichia coli and *Klebsiella pneumoniae* as the majority microorganisms. The study of antibiotic susceptibility of the different strains revealed significant resistance to the main molecules used in common practice.

Conflict of Interest

None.

Authors' contributions

All authors contributed to the development and declare that they have read and approved this manuscript.

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