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PREVALENCE AND SUSCEPTIBILITY PROFILE OF BACTERIA ISOLATED FROM UROCULTURES OF OUTDOOR AND INTERNAL PATIENTS AT HOSPITAL UNIVERSITÁRIO DE BRASÍLIA BETWEEN 2017 AND 2018

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Abstract: Urinary tract infection (UTI) is a very common health problem worldwide. UTI defines both lower urinary tract infections (cystitis) and upper urinary tract infections (pyelonephritis). **Goal:** The objective of this study is to identify the main bacteria responsible for urinary tract infections, as well as to trace their antimicrobial resistance profile. **Materials and methods:** Patients of all age groups and both genders were included in the study, all attended at the Hospital Universitário de Brasília between January 2017 and December 2018. Results: Among the 13,259 patients studied, 6,330 were seen in 2017, with 800 (12.64%) positive samples and 4,687 (74.04%) negative samples for bacterial growth, with 843 (13.32%) contaminated samples. A total of 6,929 patients were treated in 2018, with 4,973 (71.77%) negative samples, 1,116 (16.11%) positive samples and 840 (12.12%) contaminated samples. **Conclusion:** Continuous surveillance work on the main pathogens involved in infections, as well as their susceptibility profiles to antimicrobials, are extremely important, as they support clinicians when choosing the antibiotic.
Keywords: Urinary tract infection, antimicrobial resistance, antimicrobial susceptibility profile.

INTRODUCTION

Urinary tract infections (UTIs) are common human microbial diseases that affect the kidneys, bladder, urethra, and prostate. These infections are widespread globally with direct and indirect social and economic effects. In addition, such diseases are becoming an emerging cause of morbidity, estimated to affect around 150 million people worldwide each year (Folliero et al., 2020).

The distribution of infections changes according to age, gender, catheterization, hospitalization and long-term use of antimicrobials (Mohammed et al., 2016). Bacteria represent the main cause of urinary tract infection, although viruses, fungi and parasites may be involved in the development of this infection (Kitagawa et al., 2018). Gram-negative bacteria are responsible for 90% of cases of urinary tract infection, while gram-positive bacteria are responsible for the other 10%. Previous studies suggest that the main bacteria involved in these infections is Escherichia coli, which appears in 65% to 90% of infections. Other uropathogens that cause urinary tract infections include Enterococcus species, Klebsiella pneumoniae, Citrobacter species, Pseudomonas aeruginosa, and coagulase-negative Staphylococcus (Rowe & Juthani-Metha, 2014).

Urinary tract infections disproportionately affect adult women, most of whom are taken to the doctor for treatment of symptoms. Postmenopausal women are more vulnerable. Symptoms are typically acute, including dysuria, urinary frequency and urgency, suprapubic flank pain, hematuria, fever, and a history of complicated urinary tract infection. The clinician's judgment with this knowledge of the symptoms may raise the diagnostic hypothesis of infection. Physical testing includes pelvic and abdominal urology examinations to detect conditions such as genitourinary atrophy in postmenopausal women, urethral diverticulum, evidence of fecal soiling, and vaginal prolapse beyond the hymen. Recurrent urinary tract infection requires specialist evaluation and referral when treating patients with kidney stones, chronic catheterization, immunosuppression (hemodialysis and transplantation), atypical symptoms (such as pneumaturia after pelvic procedure), carcinoma in situ, vulvar and vaginal infections, scarcity of bladder, enterovesical fistula, anatomical urinary tract abnormalities and rarely genitourinary tuberculosis; must be considered, as there is a marked risk for sepsis and the presence of multidrug resistance (MDR) in hospitalized patients (Aslam et al., 2019).

The epidemiology of Urinary Tract Infections varies between countries, due to geographic variation and antibiotic use. The rapid and adequate initiation of antibiotic therapy is important for the success of the treatment, but its frequent use can result in the emergence of multidrug-resistant bacteria.

The objective of this study is to evaluate the main bacteriyears pathogens implicated in urinary tract infections and their antimicrobial susceptibility profiles in patients treated at the University Hospital of Brasília between January 2017 and December 2018. The knowledge of these data allows a better therapeutic approach using rational use of antimicrobials in cases where the institution of antibiotic therapy is necessary.

MATERIAL AND METHODS

STUDY SCENARIO

The research was transversal and retrospective, quantitative, exploratory, applied, inductive, descriptive and regarding the technical procedure it is action research. Data were collected retrospectively at the Laboratory of Bacteriology of the Hospital Universitário de Brasília, through books of records of cultures carried out from January 2017 to December 2018. The public served at the University Hospital of Brasília is quite broad, and in this research patients of different age groups and both genders were included, from newborn children and childhood stages (0 to 10 years), adolescence (11 to 17 years), young people and adults (18 to 39 years), which we can mention women of childbearing age, adults (40 to 59 years old) and the elderly (from 60 to 75 years old). The cultures analyzed were from outpatients and hospitalized patients at the University Hospital of Brasília from the Adult and Neonatal Intensive Care Units (ICU), Maternity, Surgical Clinic, Adult and Pediatric Emergency Care Unit (Urgent and Emergency), Oncology Treatment, Medical Clinic (Adult Ward), Transplantation, Hemodialysis, Coronary Unit and Pediatric Clinic.

The results were obtained from urine collected by mid-stream, preferably the first urination of the day, or after a bladder retention of two to three hours, urine via bladder catheterization, collected by a relief tube. In the laboratory routine of the bacteriology laboratory, urine is seeded on Chromo-agar and/or MacConkey agar, incubated at 37 degrees centigrade for 24 hours. The Bacteriology Laboratory has a BD® branded Phoenix 100® automated equipment for bacterial identification and sensitivity testing, the results of which are supervised by the responsible pharmacist along with the technical team.

Software and Statistical Techniques

Statistical analyzes were performed using the R software (R Development Core Team 2019, version 3.5.3).

RESULTS

The results were interpreted according to the current CLSI (Clinical and Laboratory Standards Institute) standard. 13,259 observations were made between January 2017 and December 2018. In the biennium 2017 and 2018, 9,660 negative samples (72.86%), 1,916 positive samples (14.45%) and 1,683 contaminated samples (12.69%) were observed (Table 1).

Sample	Frequency	Percentage
Negative	9660	72,86%
Positive	1916	14,45%
Contaminated	1683	12,69%
Total	13259	100%

Table 1. Frequencies of the total samples observed.

Source: ESTAT/UNB, 2020.

INPATIENTS AND OUTPATIENTS 2017

The three most prevalent bacteria in 2017 in patients admitted to the Hospital Universitário de Brasília in the survey by gender and age group were: *Escherichia coli*, *Klebsiella pneumoniae* and *Enterococcus faecalis*.

Bacterium	Gender		**Total**
	Man	Woman	
Escherichia coli	32	85	117
Klebisiella pneumoniae	38	43	81
Enterococcus faecalis	11	6	17
Total	81	134	215

Table 2. Frequencies of the three most prevalent bacteria in 2017 inpatients by gender.

Among the three most prevalent bacteria in 2017 in outpatients at Hospital Universitário de Brasília highlighted by the survey of samples by gender and age group were Escherichia coli, Klebsiella pneumoniae and the "Other" group, in the latter both gram-negative and gram-negative bacteria are found. -positives such as: *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus agalactiae*, *Staphylococcus saprophyticus*, *Enterococcus faecium*, *Pseudomonas aeruginosa*, *Morganella morganii*, *Proteus mirabilis*, *Enterobacter cloacae*, *Citrobacter koseri*, *Burkholderia ozaenae*, *Enterobacter aerogenes*, *Enterobacter gergoviae*, *Serratia marcescens*, *Providencia alcalifaciens*, *Proteus vulgaris* e *Acinetobacter baumannii.*

Bacterium	Gender		**Total**
	Man	Woman	
Escherichia coli	42	300	342
Klebisiella pneumoniae	30	46	76
Others	16	21	37
Total	88	367	455

Table 3. Frequencies of the three most prevalent bacteria in 2017 outpatients by gender.

Age	**Bacterium**			**Total**
	Escherichia coli	*Klebisiella pneumoniae*	Others	
0 to 3 years	6	3	3	12
4 to 10 years	20	1	0	21
11 to 17 years	13	1	0	14
18 to 25 years	20	3	6	29
26 to 35 years	49	8	3	60
36 to 39 years	40	3	2	45
40 to 45 years	28	8	1	37
46 to 52 years	42	10	0	52
53 to 59 years	38	8	7	53
60 to 75 years	56	23	9	88
over 75 years	30	8	6	44
Total	342	76	37	455

Table 4. Frequencies of the three most prevalent bacteria in 2017 outpatients by age group.

Inpatients and Outpatients 2018

The three most prevalent groups of microorganisms in 2018 in patients hospitalized at Hospital Universitário de Brasília, in the survey by gender and age group, were E. coli, K. pneumoniae and "Others" group in which both gram-positive and gram-positive bacteria appear. negative.

Bacterium	Gender		
	Man	Woman	
Escherichia coli	44	106	150
Klebisiella pneumoniae	37	54	91
Others	16	29	45
Total	97	189	286

Table 5. Frequencies of the three most prevalent bacteria in hospitalized patients in 2018 by gender.

Source: ESTAT/UNB, 2020.

Age	Bacterium			Total
	Escherichia coli	*Klebisiella pneumoniae*	Others	
0 to 3 years	12	4	3	19
4 to 10 years	8	0	0	8
11 to 17 years	3	0	0	3
18 to 25 years	9	5	6	20
26 to 35 years	7	9	8	24
36 to 39 years	6	6	0	12
40 to 45 years	12	4	3	19
46 to 52 years	19	15	7	41
53 to 59 years	12	3	3	18
60 to 75 years	40	30	11	81
over 75 years	22	15	4	41
Total	150	91	45	286

Table 6. Frequencies of the three most prevalent bacteria in 2018 inpatients by age group.

Source: ESTAT/UNB, 2020.

Among the three most prevalent groups of microorganisms in 2018 in outpatients at Hospital Universitário de Brasília, in the survey by gender (Figure 8 and Table 8) and age group (Figure 9 and Table 9), we highlight E. coli, K. pneumoniae and "Other" group in which both gram-positive and gram-negative bacteria appear.

Bacterium	Gender		Total
	Man	Woman	
Escherichia coli	52	351	403
Klebisiella pneumoniae	30	52	82
Others	27	44	71
Total	109	447	556

Table 7. Frequencies of the three most prevalent bacteria in 2018 outpatients by gender.

Age	Bacterium			Total
	Escherichia coli	*Klebisiella pneumoniae*	Others	
0 to 3 years	13	2	2	17
4 to 10 years	4	0	2	6
11 to 17 years	7	1	4	12
18 to 25 years	21	2	8	31
26 to 35 years	78	8	8	94
36 to 39 years	25	4	3	32
40 to 45 years	37	6	4	47
46 to 52 years	41	6	6	53
53 to 59 years	36	6	3	45
60 to 75 years	104	33	25	162
over 75 years	37	14	6	57
Total	403	82	71	556

Table 8. Frequencies of the three most prevalent bacteria in 2018 outpatients by age group.

ANTIMICROBIAL SUSCEPTIBILITY PROFILE OF STUDY BACTERIA IN STATISTICAL TABLES

Below we present epidemiological and statistical profiles of the Antimicrobial Susceptibility Test of some gram-negative and gram-positive bacteria selected in the collection of data from the research of laboratory records at the University Hospital of Brasília between 2017 and 2018.

In Table 9, Escherichia coli was more susceptible to five specific antimicrobials: Colistin, Amikacin, Meropenem, Ertapenem and Tigecycline and more resistant to: Ampicillin, Trimethoprim-Sulfamethoxazole, Ciprofloxacin, Levofloxacin and Cephalothin.

Antimicrobials	Susceptibility			Total
	Sensitive	Resistent	Intermediate	
Amikacin	1003 (99,31%)	1 (0,10%)	6 (0,59%)	1010 (100%)
Amoxicillin-Clavulanate	711 (75,56%)	99 (10,52%)	13 (13,92%)	941 (100%)
Ampicillin	403 (39,90%)	607 (60,10%)		1010 (100%)
Cephalothin	242 (37,81%)	186 (29,06%)	212 (33,12%)	640 (100%)
Cefepime	911 (90,29%)	86 (8,52%)	12 (1,19%)	1009 (100%)
Cefoxitin	739 (93,90%)	21 (2,67%)	27 (3,43%)	787 (100%)
Ceftriaxone	904 (89,50%)	103 (10,20%)	3 (0,30%)	1010 (100%)
Cefuroxime	814 (85,77%)	103 (10,85%)	32 (3,37%)	949 (100%)
Ciprofloxacin	677 (67,03%)	331 (32,77%)	2 (0,20%)	1010 (100%)
Colistin	505 (99,61%)	2 (0,39%)		507 (100%)
Ertapenem	989 (98,51%)	13 (1,29%)	2 (0,20%)	1004 (100%)
Gentamicin	927 (91,78%)	83 (8,22%)		1010 (100%)
Imipenem	761 (96,82%)	15 (1,91%)	10 (1,27%)	786 (100%)
Levofloxacin	500 (64,43%)	276 (35,57%)		776 (100%)
Meropenem	998 (98,91%)	10 (0,99%)	1 (0,10%)	1009 (100%)
Nitrofurantoin	881 (96,39%)	12 (1,31%)	21 (2,30%)	914 (100%)
Piperacillin-Tazobactam	970 (96,42%)	25 (2,49%)	11 (1,09%)	1006 (100%)
Tigecycline	487 (97,01%)	3 (0,60%)	12 (2,39%)	502 (100%)
Trimethoprim-Sulfamethoxazole	495 (49,90%)	497 (50,10%)		992 (100%)

Table 9. Bacteria susceptibility profile: *Escherichia coli.*

Source: ESTAT/UNB, 2020.

In Table 10, a *Klebsiella pneumoniae* showed greater susceptibility to: Amikacin, Colistin, Meropenem, Ertapenem and Cefoxitin. Greater resistance (in percentage scale) to: Ampicillin, Cephalothin, Amoxicillin-Clavulanate, Cefuroxime and Trimethoprim-Sulfamethoxazole.

The group "Other" microorganisms were more susceptible to five antimicrobials in the studied period: Linezolid, Vancomycin, Ertapenem, Meropenem and Amikacin, and more resistant to Benzylpenicillin, Nitrofurantoin and Colistin.

DISCUSSION

Most patients with uncomplicated recurrent urinary tract infection are prescribed 3 to 7 days of an antibiotic for each episode of cystitis. Immediate antibiotic therapy may provide specimens for urine culture and antimicrobial susceptibility testing and provides empirical therapy based on the individual's microbial history, allergy and clinical profile - eg renal function. Oral pharmacotherapy is preferred, although experts may recommend intravenous pharmacotherapy in some patients.

Antimicrobials	**Susceptibility**			**Total**
	Sensitive	Resistent	Intermediate	
Amikacin	299 (90,61%)	21 (6,36%)	10 (3,03%)	330 (100%)
Amoxicillin-Clavulanate	139 (46,64%)	149 (50%)	10 (3,36%)	298 (100%)
Ampicillin		326 (100%)		326 (100%)
Cephalothin	92 (42,79%)	118 (54,88%)	5 (2,33%)	215 (100%)
Cefepime	185 (56,75%)	137 (42,02%)	4 (1,23%)	326 (100%)
Cefoxitin	177 (67,30%)	63 (23,95%)	23 (8,75%)	263 (100%)
Ceftriaxone	167 (50,61%)	163 (49,39%)		330 (100%)
Cefuroxime	141 (45,19%)	163 (52,24%)	8 (2,56%)	312 (100%)
Ciprofloxacin	179 (54,24%)	142 (43,03%)	9 (2,73%)	330 (100%)
Colistin	158 (82,29%)	34 (17,71%)		192 (100%)
Ertapenem	215 (69,13%)	95 (30,55%)	1 (0,32%)	311 (100%)
Gentamicin	217 (66,16%)	107 (32,62%)	4 (1,22%)	328 (100%)
Imipenem	165 (62,26%)	87 (32,83%)	13 (4,91%)	265 (100%)
Levofloxacin	132 (53,44%)	113 (45,75%)	2 (0,81%)	247 (100%)
Meropenem	231 (70,21%)	82 (24,92%)	16 (4,86%)	329 (100%)
Nitrofurantoin	123 (42,41%)	113 (38,97%)	54 (18,62%)	290 (100%)
Piperacillin-Tazobactam	186 (57,23%)	119 (36,62%)	20 (6,15%)	325 (100%)
Tigecycline	56 (31,46%)	41 (23,03%)	81 (45,51%)	178 (100%)
Trimethoprim-Sulfamethoxazole	155 (50,82%)	150 (49,18%)		305 (100%)

Table 10. Susceptibility profile of *Klebsiella pneumoniae*.

Source: ESTAT/UNB, 2020.

Carbapenemases, as produced by Klebsiella pneumoniae, are a cause of resistance, whose genes can be transmitted by plasmids, and determine resistance to classes of antimicrobial agents, including fluoroquinolones [Ciprofloxacin and Levofloxacin] and aminoglycosides [Gentamicin and Amikacin] (Iwanaga et al., 2020).

The increasing emergence of resistance to macrolides (Erythromycin, for example) is a therapeutic problem among patients allergic to β-Lactams, it characterizes the so-called group B Streptococcus (Streptococcus Group B), Streptococcus agalactiae, in adult patients, especially responsible for the bacteriuria in pregnant women, and other pathological conditions such as cystitis, pyelonephritis and urosepsis. GBS-triggered urinary tract infections have been increasing since the late 20th century (Vigliarolo et al., 2019). As identified by the study, Benzylpenicillin is the option for the treatment of GBS.

The prevalence of Methicillin-Resistant Staphylococcus aureus (Methicillin-Resistant Staphylococcus aureus) with susceptibility to Vancomycin has relatively decreased. Reduced cell wall turnover and reduced autolytic activity have been reported to induce cell wall thickening and reduce the access of Vancomycin to its active site of action (Sungim et al., 2020). In the present demonstration of statistical profiles Staphylococcus aureus was sensitive to Glycopeptide Vancomycin, along with Linezolid, the folate inhibitor Trimethoprim-Sulfamethoxazole, Ansamycins Rifampicin, Tetracycline and Nitrofurans Nitrofurantoin confirming the text.

Statistically, in the present study, resistance to E. coli was noted in fluoroquinolones, first-generation cephalosporins such as Cephalothin, aminopenicillins such as Ampicillin and folate pathway inhibitors such as Trimethoprim-Sulfamethoxazole.

Pseudomonas aeruginosa is a gram-negative bacillus that causes a wide variety of community and hospital infections. This bacterium is resistant to penicillins and cephalosporins. It undergoes mutations in exogenous genetic material and chromosomal development. Thus, its resistance is a public health problem. The criteria for multidrug resistance are established by the American and European Centers for Disease Control and Prevention [CDC and ECDC] (Prado-Montoro et al., 2019). It may have presented resistance mechanisms to P. aeruginosa, in the context of the hospital environment, as it was resistant to Ertapenem and Amoxicillin-Clavulanate from the perspective of this study.

Enterococcus has been increasing the rate of resistance to Vancomycin, as well as a high level of resistance to aminoglycosides, treatment options are limited. In 2017, the WHO classified Vancomycin-resistant E. faecium (VREfm), a high-priority group of pathogens for the development of new antimicrobials. In 2000, the FDA (Food and Drug Administration) approved Linezolid including for VREfm infections. It has a bacteriostatic effect against both E. faecalis and E. faecalis species. faecium (Asgin, N. & Otlu, B., 2020). In this study, Enterococcus still showed susceptibility to Vancomycin.

For the "Others" group, what was found in the results of antimicrobials follows, with this group being the least recurrent bacteria in outpatients and hospitalized patients at the HUB.

CONCLUSION

Continuous surveillance work on the main pathogens involved in infections, as well as their susceptibility profiles to antimicrobials, are extremely important, as they support clinicians when choosing an antibiotic, contributing to a more rational use of antimicrobials and preventing the emergence of of multidrug-resistant microorganisms.

CONFLICT OF INTERESTS

There is not any.

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