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ANTIBIOTIC RESISTANCE OF BACTERIA ISOLATED FROM URINARY TRACT INFECTIONS

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ABSTRACT

The aim of this study was to evaluate the antimicrobial resistance following in vitro testing for sensitivity of isolated bacteria from uncomplicated urinary tract infections.

We analysed all results for all urine culture tests performed in a two months period, retrospectively analyzing medical record from one laboratory.

We identified E. coli in 71.4% of the positive cultures, followed by Klebsiella pneumoniae, Staphylococcus aureus and Staphylococcus epidermitis. We identified 100% resistance of Gram negative bacteria in antimicrobials such as Cefuroxime and Ticarcillin. Fosfomycin and Amikacin provided good results, with high percentage of susceptible results.

Keywords: antimicrobial resistance, urinary tract infections, treatment

Introduction

Urinary tract infections (UTIs) represent a common problem of medical praxis, both in hospitals and in primary care. Non-specific urinary tract infection is the pathological condition caused by the active presence and multiplication of microorganisms in the urine, accompanied by appropriate clinical symptoms (pain, increased micturition frequency, dysuria, incontinence, haematuria (1,2).

Non-specific infections are distinguished from specific infections, such as those produced by Mycobacterium tuberculosis, Neisseria gonorrhoea, Actinomyces sp., which cause specific diseases: tuberculosis, gonorrhoea, actinomycosis. The invasion of pathogenic microorganisms occurs both in urine and in various tissues of the urinary system (1,2). For the treatment of acute uncomplicated bacterial infections (cystitis, pyelonephritis), national and international clinical guidelines have been developed (3,4).

Resistance to antibiotics currently represents a major problem for individuals and medical systems. The misuse and overuse of antibiotics is the main promoter of antibiotic resistance, an aspect stated by all major health institutions. The misuse of antibiotics has different causes (5), related to unnecessary

prescription, a prescription that doesn't follow the guidelines recommendations, self-medication. Also, an important role when treating urinary tract infections is existing specific data for specific populations, which can identify trends in developing antimicrobial resistance.

The objective of this study is to analyse the results of in vitro testing the sensitivity of isolated bacteria from uncomplicated urinary tract infections in a group of outpatients and to evaluate the resistance to antibiotics.

Material and method

The study was completed between December 2018-January 2019, on all tests for urine culture performed in the adult population, and in case of positive results, we looked at the results for the sensitivity testing for antibiotics. The study was run retrospectively, by analysing medical records from one laboratory.

Results

In the mentioned period: December 2018-January 2019, there were analysed 138 urine samples in adult patients suspected of uncomplicated urinary tract infection (UTI), 94 females: 44 males.

Table I: Distribution of cases according to the sex of the patients

	Positive results	Negative results
Feminin	70 (74.5%)	24 (25.5%)
Masculin	28 (63.6%)	16 (36.4%)
Total	98 (71.01%)	40 (28.99%)

As seen in the table, the number of women in the study (suspected of UTI) was more than twice higher than that of men in the same period. As well, the percentage of positive cases was higher in females (74.5%) comparative to males (63.6%) (Table 1). This result not different from other authors (6,7).

Table II Bacterial species isolated:

	Frequency	Percent (%)
Escherichia coli	70	71.4
Klebsiella pneumoniae	7	7.1
Staphylococcus aureus	4	4.1
Staphylococcus epidermidis	4	4.1
Proteus spp.	3	3.1
Citrobacter freundii	2	2
Enterococcus faecium	2	2
Acinetobacter baumanii	1	1
E.coli and Staph. epidermidis	1	1
Enterobacter cloacae complex	1	1
Enterococcus faecalis	1	1
Serratia marcescens	1	1
Shigella sp.	1	1
Total	98	100

As expected, E. Coli was present in 71.4% of the cases, being thus the bacteria found with the highest frequency. It was followed by Klebsiella pneumoniae (7.1%), Staphylococcus aureus, and Staphylococcus epidermidis with 4.1% each.

We also noticed that about 90% of the isolated strains are Gram-negative bacteria.

As a consequence of these results, we analysed the sensitivity and resistance to antibacterial drugs, performed on Gram-Negative bacteria (table 3) and Gram-Positive bacteria (table 4)

We found two antibiotics: Cefuroxime and Ticarcillin showed 100% resistance (Cefuroxime was used for 7 cases, Ticarcillin for 15 cases)

Discussions

In our study, Fosfomycin, and Amikacin are antibiotics that can be recommended, as Gram-negative bacteria showed low resistance.

Cefepime (fourth-generation cephalosporin), Imipenem and Meropenem (carbapenems) are used to treat severe, complicated infections with microorganisms resistant to first-choice antibiotics.

Fluoroquinolones (Ciprofloxacin, Levofloxacin) are in the group of antibiotics within 29-39% resistance, as well as aminoglycosides: Kanamycin, netilmicin, Azithromycin.

If results are compared with other studies, we notice for some drugs a great similarity (quinolones), but in other cases significant differences (cephalosporins). (Table 5)

If antibiotic therapy is required before the

Table III: Sensitivity and resistance to antibacterial drugs, performed on Gram-Negative

	Total no. of sensitivity tests	Susceptible	Intermediate	Resistant
Amikacin	42	25 (59.5%)	12 (28.5%)	5 (12%)
Amoxicillin	27	2 (7%)	0 (0%)	25 (93%)
Ampicillin	40	4 (10%)	1 (3%)	35 (88%)
Ampicillin-sulbactam	67	11 (16%)	11 (16%)	45 (67%)
Amoxicillin-clavulanate	72	17 (24%)	12 (17%)	43 (60%)
Cefaclor	18	4 (22%)	0 (0%)	14 (78%)
Cefoperazone	18	2 (11%)	0 (0%)	16 (89%)
Ceftriaxone	76	28 (37%)	18 (24%)	30 (40%)
Ceftazidime	54	25 (46%)	4 (7%)	25 (46%)
Cefotaxime	25	7 (28%)	3 (12%)	15 (60%)
Cefuroxime	7	0 (0%)	0 (0%)	7 (100%)
Ciprofloxacin	67	28 (42%)	15 (22%)	24 (36%)
Doxycycline	32	12 (38%)	11 (34%)	9 (28%)
Cephalexin	80	59 (74%)	11 (14%)	10 (13%)
Kanamycin	21	13 (62%)	0 (0%)	8 (38%)
Levofloxacin	79	52 (66%)	4 (5%)	23 (29%)
Meropenem	31	24 (77%)	1 (3%)	6 (19%)
Netilmicin	18	12 (67%)	2 (11%)	4 (22%)
Piperacillin-Tazobactam	30	14 (47%)	6 (20%)	10 (33%)
Piperacillin	19	1 (5%)	1 (5%)	17 (90%)
Tetracycline	14	4 (29%)	0 (0%)	10 (71%)
Ticarcillin	15	0 (0%)	0 (0%)	15 (100%)
Tobramycin	16	5 (31%)	2 (13%)	9 (56%)
Trimethoprim-sulfamethoxazole	67	33 (49%)	6 (9%)	28 (42%)
Cephalothin	8	4 (50%)	1 (13%)	3 (38%)
Nalidixic acid	59	19 (32%)	2 (3%)	38 (64%)
Nitrofurantoin	22	11 (50%)	3 (14%)	8 (36%)
Fosfomycin	26	21 (81%)	0 (0%)	5 (19%)
Cefepime	16	14 (88%)	1 (6%)	1 (6%)
Imipenem	17	14 (82%)	1 (6%)	2 (12%)
Norfloxacin	36	13 (36%)	5 (14%)	18 (50%)
Ofloxacin	0	0 (0%)	0 (0%)	0 (0%)
Azithromycin	12	3 (25%)	6 (50%)	3 (25%)

sensitivity test results, international guidelines recommend Sulfamethoxazole-trimethoprim, a fluoroquinolone (Ciprofloxacin, Levofloxacin, Norfloxacin or Gatifloxacin), Nitrofurantoin or Fosfomycin.

Most of the gram-positive bacteria were resistant to beta-lactamic drugs, with the exception of cephalexin, carbapenems, first and second-generation quinolones (nalidixic acid, ciprofloxacin) for which the resistance was higher. This type of higher resistance was observed in other studies on bacteria that targets the urogenital system (8) Higher susceptibility rates were observed for aminoglycosides and levofloxacin, and in a smaller percentage, to Trimethoprim-sulfamethoxazole.

Table IV: Results for Gram-positive bacteria

	Total	Susceptible	Intermediate	Resistant
Amikacin	4	3 (75%)	1 (25%)	0 (0%)
Amoxicillin	1	0 (0%)	0 (0%)	1 (100%)
Ampicillin	2	0 (0%)	0 (0%)	2 (100%)
Ampicillin-sulbactam	5	1 (20%)	2 (40%)	2 (40%)
Amoxicillin-clavulanate	9	2 (22%)	1 (11%)	6 (67%)
Ceftriaxone	5	2 (40%)	1 (20%)	2 (40%)
Cefotaxime	2	0 (0%)	0 (0%)	2 (100%)
Ciprofloxacin	5	1 (20%)	2 (40%)	2 (40%)
Doxycycline	7	4 (57%)	1 (14%)	2 (29%)
Cephalexin	10	6 (60%)	2 (20%)	2 (20%)
Levofloxacin	9	5 (56%)	0 (0%)	4 (44%)
Meropenem	6	1 (0%)	0 (0%)	5 (0%)
Trimethoprim-sulfamethoxazole	8	2 (25%)	2 (25%)	4 (50%)
Nalidixic acid	8	0 (0%)	0 (0%)	8 (100%)
Imipenem	0	0 (0%)	0 (0%)	0 (0%)
Norfloxacin	5	0 (0%)	1 (20%)	4 (80%)
Ofloxacin	0	0 (0%)	0 (0%)	0 (0%)
Azithromycin	5	3 (60%)	1 (20%)	1 (20%)

Table V Comparative results with other studies

	Current study	Other studies (9-12)
Trimethoprim/ Sulfamethoxazole	42.7%	34% - 34.4%
Amoxicillin/ Clavulanic	60.5%	18.5 - 40.8% - 47.5%
Ampicillin	88.1%	55% - 85% - 90%
Ciprofloxacin	36.1%	9.8 - 18.1-18.7% - 20% - 27.5%
Levofloxacin	30.7%	25.6%
Norfloxacin	53.7%	26% - 75%
Piperacillin-Tazobactam	33.3%	11.3% - 11.6%
Cephalothin	37.5	80.6%
Cefuroxime	100%	20%
Amikacin	10.9%	0 - 1%
Cephalosporins Gen 3 (ceftriaxone, ceftazidime, cefotaxime)	39.5% - 63%,	10.8 – 62.16%
Cefepime	88.9%	21.9%
Imipenem	11.8%	0.6%

Conclusions

About 90% of the isolated strains were Gram-negative bacteria. E. Coli was the most frequent one, followed by Klebsiella pneumoniae and Staphylococcus spp.

Gram-negative bacteria showed an increased resistance (over 80% of the cases) to beta-lactams: ampicillin, amoxicillin, cefuroxime, (but not to cephalexin). If results are compared with other studies, we notice for some drugs a great similarity (quinolones), but in other cases significant differences (cephalosporins).

In our study, Fosfomycin, and Amikacin are antibiotics that can be recommended, as Gram-negative bacteria showed low resistance.

Imipenem, Cefepime (fourth-generation cephalosporin), and Meropenem (carbapenems) are recommended in the treatment of severe, complicated infections with microorganisms resistant to first-choice antibiotics.

Fluoroquinolones (Ciprofloxacin, Levofloxacin) are in the group of antibiotics within 29-39% resistance, as well as aminoglycosides: Kanamycin, Netilmicin, Azithromycin.

Gram-positive bacteria were resistant to beta-lactam drugs, except Cephalexin,

carbapenems, first and second-generation quinolones (Nalidixic acid, Ciprofloxacin), and were more sensitive to aminoglycosides, levofloxacin, and in a smaller percentage, to Trimethoprim-sulfamethoxazole.

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