Tobruk University Journal for Medical Sciences (TUMJS) ISSN No 27892093 Volume (7): Issue1 10 Jan 2024
Original Article

Sensitivity and Resistance Patterns of Urinary Tract infections

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Received 04Sept 2023; Accepted 10 Nov 2023; published 10 Jan 2024
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Abstract

Objectives: To identify the most common bacteria causing urinary tract infections (UTI) and their sensitivity and resistance patterns for some antimicrobial agents. Methodology: A total of 773 cases from outpatients and inpatients attended Al-Wahda therapeutic and teaching hospital, Derna - Libya, clinically suspected as having UTI during 2021 and 2022, were examined for microbiological and pattern of antibiotic susceptibility by disc diffusion method. Results: By using direct smear microscopy and routine culture methods, different bacterial species were isolated from only 262 (33.9%), the remaining 511 (66.1%) of cases showed no bacterial growth. Bacteriological examination of urine showed *that Escherichia coli* was found in 106 (40.4%) of cases, *Klebsiella* in 59 (22.5%), *Staph. epidermidis* in 35 (13.3%), *Staph. aureus* in 32 (12.2%), *Proteus* spp. in 12 (4.5%), *Pseudomonas* in 8 (3%), Enterococci in 6 (2.3%), and *Corynebacteria* in 4 (1.5%) of cases. The antimicrobial sensitivity pattern in the treatment of UTIs indicated that the Ciprofloxacin shows (80.2% sensitivity) , Amoxicillin (70.2%), Nitrofurantoin (64.5%), and Ceftriaxone (61.8%). Meanwhile, for treating UTI produced by *Enterococci*, the antimicrobial drug of choice is Amoxicillin (70.2% sensitivity), Nalidixic acid (60.3% sensitivity), and Ampicillin (9.2% sensitivity), while for treating *Pseudomonas* spp, the drug of choice should be member of Fluoroquinolones group as Ciprofloxacin (80.2% sensitivity), and Sulfamethoxazole plus Trimethoprim (26.3% sensitivity). Conclusion: Urinary tract infection is a major cause of morbidity, especially in young children. Trends in choice of antibiotic treatment may change depending on locally determined resistances, common pathogens, and cost issues.

Keywords: Urinary tract infections (UTI), bacteria. disc diffusion method, Antibiotic sensitivity / resistance drugs.

Introduction

Antibiotics are used to prevent infection and to treat patients with proven or suspected infections, and to administer a safe and cost-effective dose of antibiotics that will eliminate the infecting or potentially infecting organism [(1)]. Antibiotics are widely used, contributing to 35% of all prescriptions in health care facilities [(2)]. Overuse of antibiotics results in bacterial resistance not only to the antibiotic prescribed, but often to other antibiotics in the same classes or groups [(3)]. When infections from Antimicrobial Resistant Organisms occur, there is increased mortality, especially among those with underlying diseases or multiorgan failure [(4)].

In the past 30–50 years, the natural history of urinary tract infection (UTI) has changed because of the introduction of antibiotics and improvements in healthcare. This change has contributed to uncertainty about the most appropriate and effective way to manage UTI and whether investigations and follow-up are justified. UTI is a common bacterial infection in children, found in up to 5% of all febrile children under the age of 2 years presenting to emergency rooms [(5)]. A population-based study from the UK based on referral data collected over 4 years suggested that 11.3% of females and 3.6% of males will have had a UTI by the age of 16 [(6)].

Studies suggest that UTI has the incidence of first time and recurrent episodes of UTI in general practice ranges from 0.6% and 1.1% in boys and girls, respectively, aged under 1 year while it changes to 0.2% and 1.4% for boys and girls, respectively, aged between 5 and 14 years [(7)].

Different antimicrobial regimens have been used in the treatment of UTI, differing in both type and duration of treatment. However, there is no consensus as to which antimicrobial should be used and how long treatment should be continued. The aim of the present study is to achieve more consistent clinical practice, based on accurate laboratory diagnosis and effective management hence reducing the emergence of other resistant forms of bacteria and minimizing the costs due to unnecessary antibiotic abuse, and to identify the most common bacteria causing urinary tract infections (UTI) and their sensitivity / resistance pattern of some antimicrobial agents.

Materials and Methods

A total of 772-midstream urine samples sent for microbiological study at the Central Lab. of Al-Wahda therapeutic and teaching hospital, Derna - Libya, were studied during six months from October 2021 to March 2022. Patients were clinically diagnosed according to criteria already established for UTI diagnosis [(8)]. A clean midstream urine sample is the recommended method for urine collection. In babies and infants' urine samples were collected in sterile self-adhesive plastic bags. When it was not possible or practical to collect urine by non-invasive methods, catheter samples 23(2.97%) or suprapubic aspiration (SPA) 7 (0.9%) were used. Before SPA is attempted, ultrasound guidance should be used to demonstrate the presence of urine in the bladder. Samples were sent to the laboratory within one hour after voiding when possible or kept refrigerated at 4^0C to avoid multiplication of bacteria in urine resulting in false significant bacteriuria. Direct smear microscopy stained with Gram's stain and routine bacterial cultures (MacConkey agar, Mueller –Hinton agar, COLUMBIA agar base) were done. The quantitation of bacteria in urine samples was done using calibrated loops for cultivation. Antibiotic sensitivity test was supplied by Himedia Laboratories PVT. LTD. 23, Vadhani Ind, Est., LBS Marg, Mumbai- 400086, India, and Oxoid LTD., DasinGstoke, Hampsttire. England.

Results

The study included 773 urine samples from patients clinically diagnosed as UTI in Al-Wahda therapeutic and teaching hospital.

Figure (1) shows that out of the 773 cases examined microbiologically 262 had growth on bacterial cultures, 173(66%) of them were children under 12 years old.

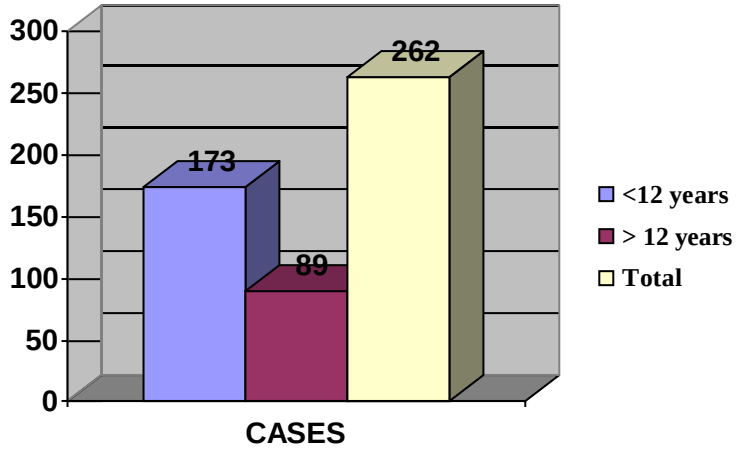

Fig. (1) Age distribution among All cases of positive culture.

Table (1) shows that UTI patients with no bacterial growth, represented 511 (66.1 %), meanwhile cases with positive bacterial growth, represented 262 (33.99 %).

Table (I) Frequency distribution of cases with positive cultures during study period.

MONTH	CASES WITH UTI	NO. OF +VE CULTURE	PERCENTAGE
October 2003	197	58	29%
November 2003	150	62	41%
October 2004	244	91	37%
November 2004	182	51	28%
Total	773	262	100%

The isolated pathogenic bacteria causing UTIs were *Escherichia coli* strains isolated in 106 (40.46%) in cases with UTI, *Klebsiella* in 59 (22.52%), *Staph. epidermidis* in 35 (13.3%), *Staph. Aureus* in 32 (12.12%), *Proteus* spp. in 12 (4.5%), while 8 (3.05%), 6 (2.29%), 4 (1.53%) of cases were produced by *Pseudomonas*, *Enterococci* and *Corynebacteria*, respectively. (Figure 2).

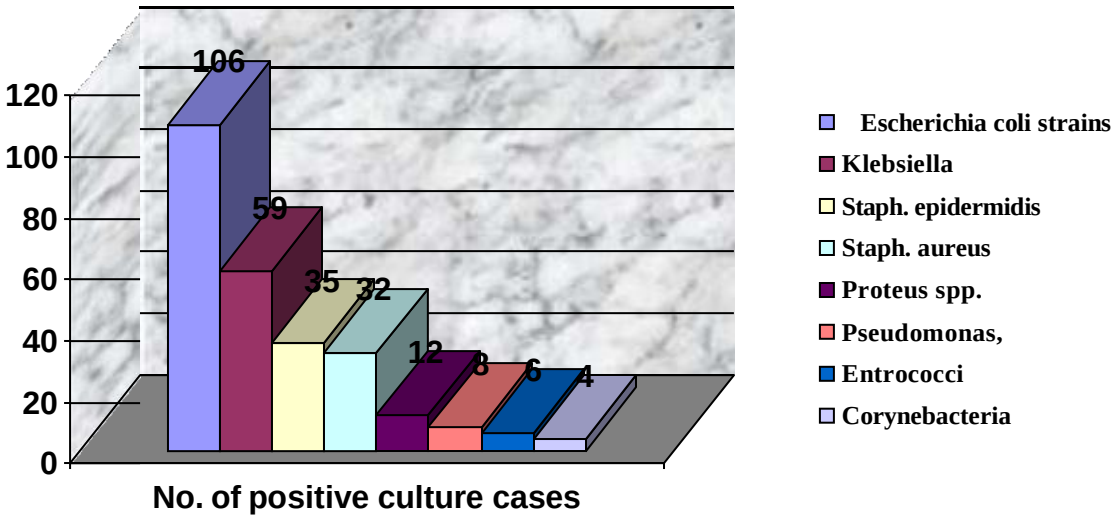

Fig. (2) The frequency distribution of pathogenic bacteria in positive cases.

Table (2) shows that *Escherichia coli* is the commonest cause of urinary tract infections especially in children, it was isolated from 106 (40.46%) cases with clinically suspected UTI. The pattern of antibiotic sensitivity for that isolated *Escherichia coli* strains from urine samples was as follows: Ampicillin 9.4%, Amoxycillin 70.8%, Nalidixic acid 67.9 %, ceftriaxone 73.6 %, sulfamethoxazole + trimethoprim 25.5%, cephalothin 21.7%, ciprofloxacillin 85.5 %, Nitrofurantoin 71.7%, chloramphenicol 48.1%, Doxycycline 21.7%. *Klebsiella* organisms are Gram negative, non-motile, capsulated bacilli representing 59 (22.52%) of all isolated cases. Its pattern of antibiotic sensitivity was as follows: Ampicillin 0 %, Amoxycillin 71.2 %, Nalidixic acid 59.3%, Ceftriaxone 67.8%, Sulfamethoxazole +Trimethoprim 20.3%, Cephalothin 20.3%, Ciprofloxacin 71.2%, Nitrofurantoin 52.5%, Chloramphenicol 57.6%, Doxycycline 25.4%. *Staphylococcus aureus* are Gram positive cocci arranged in bunches, catalase, and coagulase positive were isolated from 32 (12.21%) cases with UTIs. Its pattern of antibiotic sensitivity was as follows: Ampicillin 9.4%, Amoxycillin 71.9%, Nalidixic acid 75%, Ceftriaxone 40.6%, Sulfamethoxazole + Trimethoprim 15.6%, Cephalothin 53.1%, Ciprofloxacin 75%, Nitrofurantoin 62.5%, Chloramphenicol 46.9%, Doxycycline 37.5%. *Staphylococcus epidermidis* are Gram positive cocci arranged in clusters, novobiocin sensitive and coagulase negative were isolated from 35 (13.35%) cases with UTIs. Its pattern of antibiotic sensitivity was as follows Ampicillin 8.5%, Amoxycillin 82.8%, Nalidixic acid 40.0%, Ceftriaxone 42.8%, Sulfamethoxazole + Trimethoprim 27%, Cephalothin 83.8%, Ciproflxacillin 81.1%, Nitrofurantoin 78.4%, Chloramphenicol 20%, Doxycycline 31.4%.
Enterococci are Gram positive cocci arranged in short chains or mostly in pairs, and catalase negative were isolated from 6 (2.29%) cases with UTIs. Its pattern of antibiotic sensitivity was as follows Ampicillin 83.3%, Amoxycillin 100%, Nalidixic acid 66.7%, Ceftriaxone 100%, Sulphur methimazole + Trimethoprim 0%, Cephalothin 83.3%, Ciprofloxacin 50%, Nitrofurantoin 33.3%, Chloramphenicol 50%, Doxycycline 0%. *Pseudomonas spp are* motile Gram-negative bacilli, strictly aerobic and non-spore forming bacteria. The only species pathogenic for humans, pyocyanin, which gives the color to "blue pus", were isolated from 8 (3.05%) cases with UTIs. Its pattern of antibiotic sensitivity/resistance as follows: Ampicillin 0%, Amoxycillin 0%, Nalidixic acid 12.5%, Ceftriaxone 25%, Sulphur methimazole + Trimethoprim 100%, Cephalothin 0%, Cipro floxacillin 87.5%, Nitrofurantoin 0%, Chloramphenicol 0%, Doxycycline 12.5%. *Proteus spp.* is Enterobacteriaceae characterized

by swarming motility and urease production, representing 12 (4.58%) from all isolated cases. Its pattern of antibiotic sensitivity was as follows: Ampicillin 0%, Amoxycillin 41.6%, Nalidixic acid 50%, Ceftriaxone 66.6%, Sulfamethoxazole + Trimethoprim 50%, Cephalothin 16.6%, Cipro floxacillin 75%, Nitrofurantoin 66.6%, Chloramphenicol 41.6%, Doxycycline 25%. *Corynebacteria* are Gram positive aerobic, non-motile, non-spore forming bacilli represent the lowest isolated cases in the study 4 (1.53%) from all isolated cases. Its pattern of antibiotic sensitivity was as follows: Ampicillin 75%, Amoxycillin 75%, Nalidixic acid 75%, Ceftriaxone 25%, Sulfamethoxazole + Trimethoprim 50%, Cephalothin 100%, Ciprofloxacin 100%, Nitrofurantoin 100%, Chloramphenicol 0%, Doxycycline 75%. The antibiotic sensitivity patterns for all isolated pathogenic bacteria were as follows: Ampicillin 9.2%, Amoxycillin 70.2%, Nalidixic acid 60.3%, Ceftriaxone 61.8%, Sulfamethoxazole + Trimethoprim 26.3%, Cephalothin 35.5%, Ciprofloxacin 80.2%, Nitrofurantoin 64.5%, Chloramphenicol 43.1%, Doxycycline 26.3%.

Table (2): Pattern of antibiotic sensitivity among isolated organisms.

	ECOLI	KLEBS	STAP.A.	STAP. E	PSEUD.SP P	PRO.SP P	CORY N	ALL
Ampicillin	9.4	0	9.4	8.5	0	0	75	9.2
Amoxicillin	70.8	71.2	71.9	82.8	0	41.6	75	70.2
Nalidixic A	67.9	59.3	75	40	12.5	50	75	60.3
Ceftriaxone	73.6	67.8	40.6	42.8	25	66.6	25	61.8
Sulfa	25.5	20.3	15.6	27	100	50	50	26.3
cephalothin	21.7	20.3	53.1	83.8	0	16.6	100	35.5
Ciprofloxacin	85.5	71.2	75	81.1	87.5	75	100	80.2
Nitrofurantoin	71.7	52.5	62.5	78.4	0	66.6	100	64.5
Chloramphenicol	48.1	57.6	46.9	20	0	41.6	0	43.1
Doxycycline	21.7	25.4	37.5	31.4	12.5	25	75	26.3

Discussion

The present study showed that urinary tract infection is a major cause of morbidity especially in young children, 173 (66%) out of 262 cases showed growth on bacterial cultures, received during the six months period of study. In many studies, the majority of patients (46%) belonged to the 13 to 60 month age group and this coincides with studies from Zaire (Wammanda and, Ewa, 2002) [(9).] , Turkey (Arselan et al., 1999) [(10)], Kuwait (Saleh et al., 2003) [(11)], and Iran (Modarres and, Nassiri , 1997) [(12)]. This could be because of the reason, as reported by other studies, that this age group of 13 - 60 months is more susceptible to infections due to their toilet training problems. The number of patients was less in the neonatal period and the cases increased with the increasing age and declined after the thirteen years of age till fifteen years [(13)]. Trends in choice of antibiotic treatment may change depending on locally determined

resistances, common pathogens, and cost issues. In Al-Wahda therapeutic and teaching hospital, during 2021 and 2022 in the UTI patients we found that *E. Coli* was the most common pathogen 40.46% (106/262) and was most sensitive to Ciprofloxacin (85.8%) with noticeable resistance to Ampicillin (90.6%resistance). *Klebsiella* was the second most common pathogen 22.5% (59/262) against which Ciprofloxacin and Amoxicillin were most sensitive (71.2%) for both, with clear resistance to Ampicillin (100%) and Cephalothin (79.7%). *Staph epidermidis* was the third revealed pathogen 13.35% (35/262) against which Amoxycillin and Cephalothin (82.8%), (83.8%) respectively were most sensitive. n*Staph aureus represented* 12.21% (32/262) of cases, Nalidixic acid and Ciprofloxacin were the most sensitive 75% with clear resistance to Ampicillin (90.6%). *Enterococcus* 2.29% (6/262) of cases, Amoxycillin and Ceftriaxone were the most sensitive 100% while Doxycycline was resistance in all cases 100%. *Pseudomonas* 3.05% (8/262) of cases. Sulfamethoxazole + trimethoprim (Co-Trimoxazole) was most sensitive in all cases 100%, while Ampicillin, Amoxycillin, Cephalothin, Nitrofurantoin and Chloramphenicol were most resistance in all cases 100%. *Proteus* spp. represented 4.58% (12/262) of cases. Ciprofloxacin was sensitive in 75% of cases, while Ampicillin was resistant in all cases 100%. *Corynebacter*ia was the least common organism seen in UTIs 1.6 % of cases (4/262). Cephalothin, Ciprofloxacin and Nitrofurantoin sensitivity were 100% in all cases, while Chloramphenicol was resistant in all cases 100%, Ceftriaxone was only sensitive in 75 % of cases. UTI and asymptomatic bacteriuria are common in the elderly, most often due to *Escherichia coli (E. coli)* colonization. For example, in one study the prevalence of bacteriuria in an elderly ambulatory population was 18 % in women and 6 %in men. The prevalence increases in women, with age and institutionalization [(14)]. The organisms infecting the urinary tract in this study were E. coli (71%), Klebsiella pneumoniae (13%), Proteus species (11%), Staphylococcus (4%), Pseudomonas (1%) in their descending order of percentages. These results are like many published articles (Waisman et al., 1999, Modarres and Nassiri, 1997). E. coli was found in 58,06% of the cases, Clostridium perfringens-9.67%, Proteus-3.22%, Enterobacter-3.22%, others-9.67%, association-16.12%, respectively, as expected in cases with many and/or prolonged periods of hospitalization.

In the present study, the most sensitive antibiotics to all isolated bacteria were Ciprofloxacin 80.2 % and Amoxycillin (70.2%), while Ampicillin was the least sensitive only in 9.2%, among all UTIs cases. Although many clinicians favor the use of Ampicillin or Co-amoxiclav, believing it will have a higher 'hit rate', we concluded that we should be using less Ampicillin and Co-amoxiclav for empirical treatment. We recommended the use of more Ciprofloxacin for empirical treatment, with three-day courses or Ceftriaxone in case of the parenteral route.

Certain differences may change our treatment policies, such as the effect of antibiotic side effects, particularly relating to renal function, altered antibiotic resistances compared to younger populations. Again, few studies addressing these issues exist, and decisions are made anecdotally. The following antibiotics are the most sensitive antibiotics in all UTIs cases, firstly, Ciprofloxacin 80.2%, Amoxicillin 70.2%, Nitrofurantoin 64.5 %, and Ceftriaxone 61 %.

Conclusion

Urinary tract infection is a major cause of morbidity, especially in young children. Trends in choice of antibiotic treatment may change depending on locally determined resistances, common pathogens, and cost issues. In the notable absence of studies in the treatment of uncomplicated UTI we recommend empirical antimicrobial treatment based on local sensitivities which should be changed once the local pattern of sensitivities are known.

Recommendations

A follow up comparative study is recommended to compare the development of new resistant strains of the above cultured microorganisms to the list of antibiotics tested.

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