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Bacterial Uropathogens of Community-Acquired Urinary Tract Infection and Their Sensitivity to Antibiotics at Suwaiq Polyclinic

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ABSTRACT

Objectives: Urinary tract infection (UTI) is a common presentation in outpatient clinic. Most of physicians start empirical treatment without sending urine culture. Knowing the local sensitivity pattern of uropathogens will help guide rational antibiotic choice for UTI. We aimed to find out the most common urinary tract pathogens in adults and their sensitivity pattern for the oral antibiotics that are available in Suwaiq polyclinic. *Methods:* We retrospectively conducted a single center observational study of urine culture and sensitivity results of adult patients more than 18 years old in Suwaiq polyclinic between January 2013 and December 2015. The patients' demographic characterizations were obtained from their medical records. All samples were sent to the regional secondary hospital and processed within 24 hour of collection. The antimicrobial susceptibility test was done on Mueller-Hinton Agar using Kirby-Bauer disc diffusion technique. *Results:* The study included 673 patients. Two third of the included patients were females (76.6%) and one third were males (23.4%). Five main organisms were isolated from all samples.



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The most common organism was E.coli (68.8%) followed by Klebsiella (15.6%) while other gram negative bacteria represents (4.7%). Gram positive organisms were mainly Staphylococcus, saprophyticus and streptococcus species constitutes (10.9%). (97.7%) of isolated E.coli were sensitive to nitrofurantoin and (72.7%) were sensitive to cotrimoxazole. They were highly resistant to ampicillin and amoxicillin (72.7% and 70.5% respectively). Sensitivity of isolated species to cefuroxime, augmentin and ciprofloxacin were (65.9%, 63.3% and 63.3%) respectively. Isolated Klebsiella species were mostly resistant to ampicillin (100%), amoxicillin (90%) and cephradine (100%) while they were sensitive to all other oral antibiotics (\geq 90%). Isolated gram positive organisms were sensitive to all antibiotics with sensitivity pattern (\geq 85%). Overall there was a high sensitivity pattern to nitrofurantoin (93.8%) and a high resistance to ampicilin and amoxicillin (70.3%, 67.2%) respectively. *Conclusion:* E.coli is the predominant uropathogen that cause UTI in adults followed by K.pneumonia. E.coli is sensitive to nitrofurantoin that is not widely used and highly resistant to commonly prescribed antibiotics.

Keywords: Urinary Tract Infections; Escherichia coli; Antibiotic Resistance; community-acquired; uropathogens.

Urinary tract infection is the microbial invasion of the sterile urinary tract.¹ It is a very common disease in the community^{1,4} affecting mostly Young women and elderly men.⁵ It also widely recognized in patient with urinary outflow obstruction due to neurological or structural abnormalities and in diabetic patients.⁶

Types of UTI depend on the site of the infection : urethritis, cystitis, and pyelonephritis.⁷Acute uncomplicated cystitis is the most common type of urinary tract infections encountered in clinical practice.⁵ It is most commonly presented by burning micturition, urinary frequency, and suprapubic discomfort. In the UK it is the second most common disease in women.³

It has been estimated that E.coli responsible for 90% of community-acquired urinary tract infection in women.⁶ Occasionally other gram negative organism encountered like Klebsiella and proteus. ⁷ Antibiotics are usually started before the result of the urine culture. In the majority of cases starting empirical treatment is much cheaper than sending urine culture itself.² In order to start the right



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antibiotics, there should be a knowledge about the common types of bacteria that cause urinary tract infection in the community and their sensitivity pattern to the available antibiotics in that community.^{2,8,9} This is because there is significant variation in the rate of drug-resistant pathogens to the widely used antibiotics in different geographic areas.⁷

So studies addressing the uropathogenic resistance pattern at the local and national level are very importance to help physicians in empiric antibiotic therapy.² Keeping in mind even after clearing the infection by the appropriate antibiotics, it is expected that there is 25% chance after six months to develop second UTI and 46% over 12 months. This high recurrence rate increases the burden of the disease.¹

It has been estimated that up to half of the prescribed anti-infective agents recommended for individuals are not required.⁹ This play a major role in increasing antibiotics resistance world-wide.¹⁰ Antibiotics resistant organism leads to increase costs to the healthcare system which can be easily avoided by proper use of antibiotics.⁹ So we will be able to control the resistance as eradicating this growing issue would be impossible. In the US around more than two million people get infected with antibiotics resistance microorganism with Around 23,000 death as a result.¹¹

Thus, we aimed to find out the common uropathogens that cause community-acquired urinary tract infections in Suwaiq polyclinic and to demonstrate the sensitivity pattern of the isolated organisms to the available antibiotics in the polyclinic. This will help to generate local data that can help health care authorities to put a local guide for antibiotics use in case of community acquired UTI.

METHODS



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We conducted a retrospective observational study in Suwaiq polyclinic in Suwaiq Town. Suwaiq is the largest Town in Sultanate of Oman. It is around 100 Km from the capital city, Muscat.

All data was collected from computer medical records for all urine culture that was processed between January 2013 and December 2015. The isolated species and their sensitive pattern were recorded in the data collection sheet that was designed by the principal investigator. The patient registration number, age, gender and date of specimen collection were documented.

We included all adult Omani patients more than 18 years who were presented to OPD with symptomatic UTI and urine culture was positive with 1-2 species of organism identified with at least 10^5 cfu/ml, they were 673 patients. We excluded all adult patients with indwelling urinary catheter inserted more than two days, recently discharged from a hospital (within three days of presentation), history of recent genitourinary tract instrumentation and any urine culture with mixed bacterial growth or candida. The sensitivity of certain antibiotics was not reported for some patient and we contacted the microbiology lab to give us the sensitivity result of the reported organism to that antibiotic.

Two Laboratory diagnostic methods were used:

1) Bacterial isolation and identification

Clean-catch midstream urine specimens were collected from each patient using sterile wide mouth glass container. The laboratory technician received the sample and kept it in the fridge at $2 - 8^{\circ}$ C to be sent to the secondary care hospital (Sohar Hospital) within 24Hour. Using 1µl calibrated plastic loops (Plastilab s.a.r.l, Lebanon), urine sample was plated on cystine lactose electrolyte-deficient (CLED) medium (BioOman, Oman) and then incubated aerobically at 37 °C overnight. The significance of a positive urine culture was assessed in terms of the number of colony forming units (cfu). Equal or more than 10^5 cfu/ml of a single potential pathogen or of each two potential pathogens were considered as positive UTI.¹²



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Less than 10^2 cfu/ml were considered as a negative UTI while 10^2 - 10^5 were considered as probable UTI. The pathogens were identified using biochemical tests according to the standard microbiological methods.¹³

2) Antimicrobial susceptibility tests

To determine antibiotic susceptibility pattern of the isolated bacteria, Kirby-Bauer disk diffusion technique were used. This method was done on Mueller-Hinton agar (BioOman, Oman) according to Clinical and laboratory Standards Institute (CLSI) guidelines. The antimicrobial agents (Oxoid, England) tested were: ampicillin (10 μ g), augmentin (30 μ g), gentamicin (10 μ g), ciprofloxacin (5 μ g), cefuroxime (30 μ g), cefotaxime (30 μ g), nalidixic acid (30 μ g), trimethoprimsulfamethoxazole (25 μ g), tetracycline (30 μ g), doxycycline (30 μ g), nitrofurantoin (300 μ g), and amikacin (30 μ g). The antimicrobial susceptibility results were interpreted according to CLSI (CLSI, 2013). Reference strains of E. coli ATCC 25922 and Staphylococcusaurous ATCC 25923were used for quality control for antimicrobial susceptibility test.¹⁴

Statistical analysis

We used SPSS version 20 to perform the statistical analysis and descriptive statistics were reported using frequency, percentage and graphs.

RESULTS

The study included 673 urine samples of adult patients between January 2013 and December 2015 that were sent for culture analysis. Out of this 534 showed no growth , 3 samples of patients with documented history of recent antibiotics uses , 44 samples with documented history of catheter in situ , 27 samples with mixed growth , 1 sample for patient with documented history of recent instrumentation, 1 sample was rejected from lab because of urine leak. 64 samples were included in this study for analysis .Mean age of included patients was 46 years with Standard deviation (SD) 18.2. Females represent 76.6 % and males 23.4%.



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Most of the isolated organisms were gram negative (89.1%) [Figure 1] and the gram positive organisms represent only (10.9%). E.coli was the most common pathogen (68.8%), followed by Klebsiella pneumonia (15.6%). Other gram negative organisms that were encountered: Serratia marcescens, genus Acetobacter and Enterobacter Cloacae, they all represent (4.7%).



Figure (1): Frequency of the bacterial species isolated from urine samples of adults patients with community acquired urinary tract infection (n = 64).

Isolated E.coli strains showed significant susceptibility to nitrofurantoin (97.7%) [Figure 2] and their sensitivity to cotrimoxazole was (72.7%). They were highly resistant to ampicillin and cephradine with resistance rate of (72.7%) and (97.7%) respectively. They had approximately similar sensitivity pattern for cefuroxime, augmentin and ciprofloxacin (65.9%, 63.6% and 63.6%) respectively. Isolated Klebsiella Pneumonia showed resistant to ampicillin (100%), amoxicillin (90%) and cephradine (100%). It was highly sensitive to cefuroxime (90%), augmentin (90%), ciprofloxacin (90%), trimethoprim-sulphamethaxazole (100%) and nitrofurantoin (100%) [Figure 2].



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The gram positive organisms were highly sensitive to all oral antibiotics (>80%) except for ampicillin (36.8 %) [Figure 2].



Figure (2): Antibiotic sensitivity pattern to isolated uropathogens.

Overall isolated uropathogens were highly susceptible to nitrofurantoin (93.8%). Sensitivity to cotrimoxazole was (79.7%). Cefuroxime, ciprofloxacin and augmentin have approximately similar sensitivity pattern: (70.3%, 71.9% and 68.8%) respectively. Nalidixic acid has sensitivity rate of (56.8) [Figure 3].



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Figure (3): Frequency of bacterial sensitivity for nine antibiotic tested of all the positive urine samples of adults patients with community acquired urinary tract infection (n = 64).

DISCUSSION

The microbial invasion of the sterile urinary system is known as a urinary tract infection. It is a fairly prevalent illness in the community^{1,4} that primarily affects young women and elderly men. It is also frequently acknowledged in diabetic patients and people with restriction of the urine outflow caused by structural or neurological problems.⁶

It has been estimated that E.coli responsible for 90% of community-acquired urinary tract infection in women.⁶ Occasionally other gram negative organism encountered like Klebsiella and proteus. ⁷ Antibiotics are usually started before the result of the urine culture. In the majority of cases starting empirical treatment is much cheaper than sending urine culture itself.² In order to start the right antibiotics, there should be a knowledge about the common types of bacteria that cause urinary tract infection in the community and their sensitivity pattern to the



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available antibiotics in that community.^{2,8,9} This is because there is significant variation in the rate of drug-resistant pathogens to the widely used antibiotics in different geographic areas.⁷

Thus, we aimed to find out the common uropathogens that cause community-acquired urinary tract infections in Suwaiq polyclinic and to demonstrate the sensitivity pattern of the isolated organisms to the available antibiotics in the polyclinic. This will help to generate local data that can help health care authorities to put a local guide for antibiotics use in case of community acquired UTI.

This study is the first study in Oman targeting the antibiotic sensitivity pattern of the pathogens that cause community acquired urinary tract infection. Our study revealed that two thirds of patients with UTI were females, E.coli was the predominant uropathogen followed by K.pneumonia. Isolated E.coli was sensitive to nitrofurantoin that is not widely used and highly resistant to commonly prescribed antibiotics.

In this study the vast majority of patients with UTI were females (76.6%) and males constitute only minority (23.4%). This is similar to what is known worldwide and found by other investigators.^{5,6,15–21} The most common uropathogens in our community is E.coli (70.3%) followed by Klebsiella pneumonia (15.6%). Similar pattern noted by other investigators although the percentage of contribution of each organism differs.^{4,6,15,19,21} For example in 2003 Dimitrov et al from Kuwait reported that E.coli constitute (48.6%) and similar rate was found by Al Benwan et al from Kuwait (54.9%).^{4,18} Stenfaniuk et al showed that E.coli responsible for (71.4%) of all community acquired urinary tract infection in Poland.²⁰

The prevalence of K.pneumonia was around (10 %) as compared to our finding (15.6%). High prevalence of K.pneumonia was reported by Akram from India (22%) while low prevalence was reported in two countries by Abejew et al from Ethiopia and Al Benwan from Kuwait (5.8% and 6% respectively).^{16,17} In both studies K.pneumonia was not the second most common .It was the fifth in the first study and the third in the latter.



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E.coli strains in our study were highly susceptible to Nitrofurantoin 97.7%. It could be because it is not widely prescribed. Similar high sensitivity pattern was reported by Malmartel et al from France and AL Benwan et al from Kuwait (98% and 93% respectively).^{17,18} Akram et al from India reported a very high resistant rate (80%).²¹ Investigators from Poland reported that sensitivity of E.coli to nitrofurantoin was (64%) only and they attributed this low sensitivity pattern to the increased use of Furazidin since 2011 in Poland even without prescription. It has same chemical group like nitrofurantoin.²⁰

The presented data showed the highest resistance pattern of E.coli was towards cephradine, ampicillin and amoxicillin (97.7%, 72.7%, and 70.5 % respectively). High resistance pattern of E.coli to ampicillin was reported by Dimitrov et al from Kuwait (74.3%), Somashekara et al from India (85.6%) and Abejew et al from Ethiopia (80%).^{6,4,16} While in Poland the resistance rate was (56.7%) still high but lower than the previous studies.²⁰ Similar to our amoxicillin resistance pattern of E.coli was reported by Al Benwan et al from Kuwait and Randrianirina et al from Madagascar (66% and 74% respectively).^{18,19} This could be due to that amoxicillin was widely used in these areas.

The sensitivity pattern of isolated E.coli strains to augmentin and ciprofloxacin was similar (63.6%) and this was lower than what has been shown by Al Benwan et al from Kuwait (73% and 72% respectively).¹⁸ On other hand it was significantly lower than the sensitivity pattern of E.coli to both antibiotics that was found in Madagascar by Randrianirina et al (88.5% and 83.6% respectively).¹⁹ Stefaniuk et al from Poland found also good sensitivity of isolated E.coli species to augmentin (88.2 %) but a similar sensitivity rate of isolated E.coli to ciprofloxacin (65.8 %).

The sensitivity of E.coli strains in our study to cefuroxime was (65.9 %) although cefuroxime tablet is not available in our polyclinic. Cotrimoxazole showed a higher sensitivity rate of (72.2%) which was higher than what has been



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reported by other researchers.^{4,16,18,20} Malmartel et al from France showed approximately similar sensitivity rate (76%).¹⁷

Klebsiella pneumonia in this study showed high resistance to ampicillin, cephradine and amoxicillin (100%, 100% and 90%) respectively. A much lower resistance rate of K.pneumonia to ampicillin was reported by Stefaniuk et al (56.7%).²⁰ A Lower resistance pattern towards first generation cephalosporin was reported by Al Benwan et al from Kuwait (47%).¹⁸ The presented data showed high sensitivity pattern of isolated K.pneumonia to augment ,cotrimoxazole, cefuroxime and ciprofloxacin (90%,100%,90%,90% respectively). Investigators from Kuwait found that the isolated strain of K.pneumonia in their study showed a much lower sensitivity pattern to augment ,cotrimoxazole and ciprofloxacin (79%,74% and 77 % respectively).¹⁸ A significantly lower sensitivity pattern to cotrimoxazole and ciprofloxacin was reported by Akram et al from India (47% and 53% respectively).²¹

The overall sensitivity to common oral antibiotics revealed high sensitivity to nitrofurantoin (93.8%) and very low sensitivity to cephradin, ampicillin and amoxicillin (10.9%, 29.7%, and 32.8% respectively). Sensitivity to cotrimoxazole was (79.7%), ciprofloxacin (71.9%), cefuroxime (70.3%) and augmentin (68.8%).

So in general there was a good sensitivity of E.coli (the most common uropathogen) to nitrofurantoin, but the other oral antibiotics had a limited effect on this organism.

Limitation

This was the first study in Oman targeting outpatient sensitivity pattern of uropathogens. It gave an idea about the situation in the area .The limitation of this study is that it was a retrospective study, so detailed background of all patient was not found especially in regards to recent hospitalization, recent genitourinary tract instrumentation and recent antibiotics use. It was a single center study that didn't



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involve all health care institutes in Suwaiq town. Another prospective multicenter study is recommended.

CONCLUSION

E.coli remains the most common uropathogens that causes Community-Acquired Urinary Tract Infection followed by K.pneumonia. E.coli is sensitive to nitrofurantoin that is not widely used and highly resistant to commonly prescribed antibiotics. So we recommend using of nitrofurantoin instead of other antibiotics, but judicious use of this antimicrobial is needed to avoid increasing the rate of microbial resistance to it.

Ethical consideration

This research was approved by ethical review and approval committee North Batinah Governorate (RERAC-NBG). The patients' privacy was maintained as the registration number used instead of medical record number and the information kept confidential. It was used only for the research.

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