Original Article

ID: JCDR/2012/4602:2437

Microbiology Section

Urinary Tract Infections – An overview on the Prevalence and the Anti-biogram of Gram Negative Uropathogens in A Tertiary Care Centre in North Kerala,India

SYED MUSTAQ AHMED, RAMAKRISHNA PAI JAKRIBETTU, SHANIYA KOYAKUTTY, ARYA B, SHAKIR VPA

ABSTRACT

Despite the advances in the antimicrobial therapy, Urinary Tract Infections (UTIs) tends to remain a major health hazard, which are responsible for significant morbidity, often resulting in alarming complications. A variety of organisms have been implicated in its aetiology. The indiscriminate and the inappropriate usage of anti-microbial agents has led to the emergence of resistant strains.

Aim: To determine the prevalence and the antimicrobial sensitivity pattern of uropathogens.

Methods and Materials: The urine samples from the patients at a medical college hospital , were processed according to the standard protocol over a period of one year from April 2011 to March 2012. The antimicrobial susceptibility was tested by the modified Kirby-Bauer's disc diffusion method as per the CLSI guidelines. The data was interpreted by using the WHO Net Antibiotic Susceptibility Surveillance Software.

Results: Out of 2540 urine samples, 511(20.12%) were found to be positive for microbial isolates, of which 343 samples (67.12%) were from females and 168 samples (32.36%) were from males. The highest rate of the isolation was detected in the geriatric age group i.e., 61-80 years (39.53 %). The most isolated organism was *Escherichia coli* (81.80%). The isolation rates were highest in the surgical departments (38.34%). Piperacillin/tazobactam, cefoperazone/sulbactam, imipenem and amikacin were found to be the most effective drugs among a majority of the isolates.

Conclusion: Before prescribing the antimicrobial therapy, a thorough knowledge of the susceptibility patterns of the uropathogens is essential to avoid incongruous and irrational antibacterial usage and to restrain the further development of drug resistance.

Key Words: Uropathogens, Multidrug Resistance

INTRODUCTION

Urinary tract infections are defined as diseases which are caused by the invasion of the genitourinary tract by microorganisms. Despite the advances in and the wide spread availability of antimicrobials, UTIs continue to be the most common causes of infections in hospitalized patients, accounting for approximately 40% of the hospital acquired infections [1,2]. Acute UTI is one of the most important causes of morbidity, occasionally becoming life threatening, forcing the general population to seek medical attention, and accounting for considerable health care costs. Wide spectrums of organisms are implicated in its aetiology, the most common being *Escherichia coli* [1-3] and other gram negative bacteria, followed by gram positive organisms. The culture of the urine samples is essential for identifying the organisms and their antimicrobial susceptibilities. The antibiotic therapy aims at relieving the existing symptoms and in preventing the development of complications like renal scarring. The increased emergence of antimicrobial resistance in the uropathogens, probably due to the empirical administration of anti bacterial therapy, even before the availability of the urine culture results, is a matter of growing concern worldwide [4]. This study aimed at determining the changing trends of the occurrence and the antimicrobial sensitivity patterns of the uropathogens which were isolated at a medical college hospital, which will enable the clinicians to devise and endorse a potent, competent and a rational anti bacterial policy to reduce the incidence of UTIs.

MATERIALS AND METHODS

A prospective study was carried out at a tertiary care centre in north Kerala, from April 2011 to March 2012, after getting a clearance from the institutional ethical committee. The clinical samples which were received from patients who were suspected of having UTIs were processed according to the standard laboratory methods. The sample plates which yielded a colony count of >1,00,000 Colony Forming Units (CFUs) /ml were considered as suggestive of significant bacteriuria. The uropathogens were further identified by their morphologies and biochemical characteristics. The positive isolates were tested for their antimicrobial susceptibility patterns by the modified Kirby-Bauer disk diffusion method on Mueller Hinton agar. Their sensitivities to amoxyclav (20/10 µg), ciprofloxacin (5 µg), norfloxacin (10µg), ofloxacin (5µg), amikacin (30µg), gentamicin (10µg), cefuroxime (30µg), cefepime (30µg), ceftazidime (30 µg), ceftriaxone (30 µg), cefotaxime (30 µg), cotrimoxazole(1.25/23.75µg), imipenem (10 µg), aztreonam (30µg), piperacillin/tazobactam (100/10µg), cefoperazone/sulbactam (75/10µg) and nitrofurantoin (300µg), were tested according to the Clinical Laboratory Standard Institute guidelines [5]. Escherichia coli ATCC 25922 and Pseudomonas aeruginosa ATCC 27853

were used as the control strains for the identification and the anti microbial susceptibility tests. The data were analyzed and interpreted by using the WHO Net Antibiotic Susceptibility Surveillance Software.

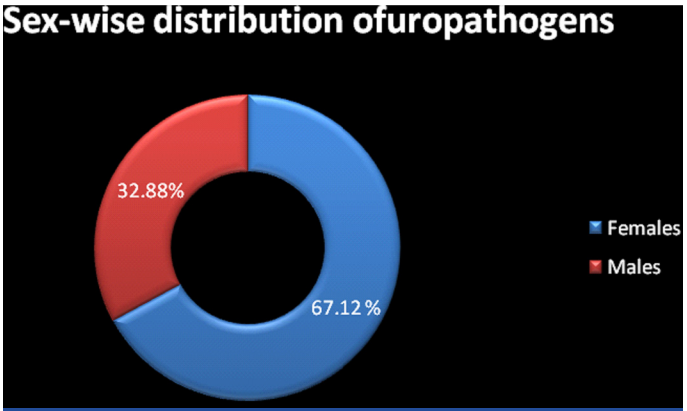
RESULTS

Out of 2540 urine samples, 511(20.12%) were found to be positive for gram negative bacterial isolates. 343 samples (67.12%) from females were culture positive, thus showing a female predominance. The highest isolation rate was found in the 61-80 years age group, thus revealing the increased vulnerability of the geriatric population to UTIs, presumably due to the various age related physiological changes [Table/Fig-1(a) and (b)].

Irrespective of the age group, *Escherichia coli* (81.80%) was found to be the predominant organism which was isolated, followed by

Organism	No. of isolates	Percentage isolation
Escherichia coli	418	81.80
Klebsiella pneumonia	76	14.87
Pseudomonas aeruginosa	14	2.74
Citrobacter freundii	3	0.59

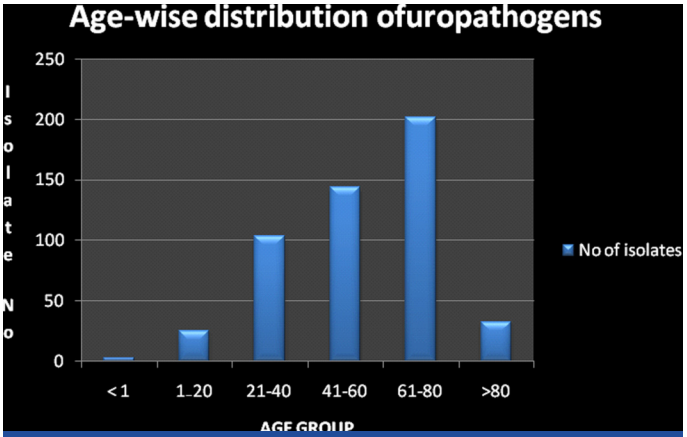
[Table/Fig-1(a)]: The organisms which were isolated from the urine samples



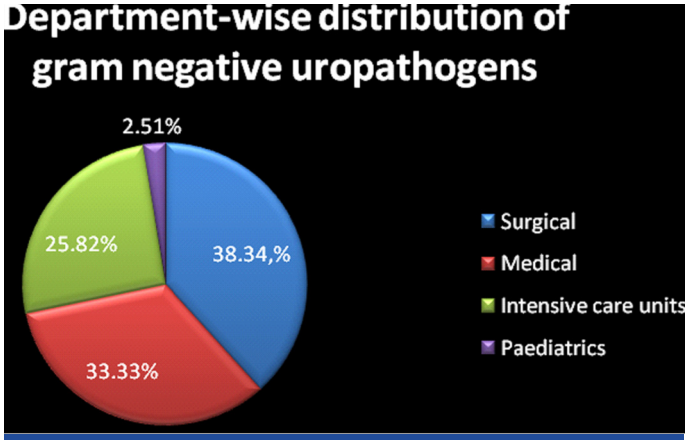
[Table/Fig-1(b)]: Sex-wise distribution of uropathogens

Isolate	<1	1-20	21-40	41-60	61-80	>80
Escherichia coli	3	21	84	119	165	26
Klebsiella pneumoniae	0	3	16	20	29	8
Pseudomonas aeruginosa	0	1	2	5	6	0
Citrobacter freundii	0	0	2	0	0	1

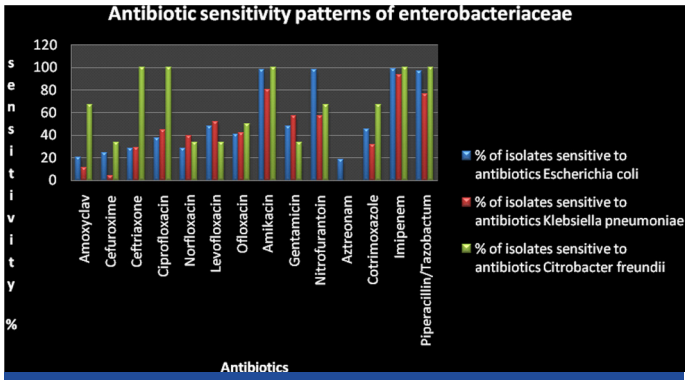
[Table/Fig-2(a)]: Age-wise distribution of uropathogens isolated during the study



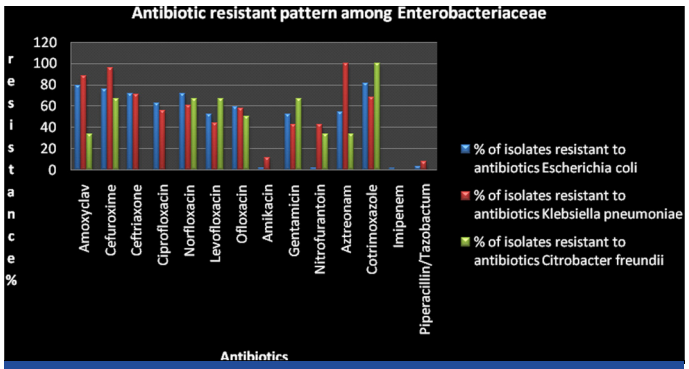
[Table/Fig-2(b)]: Age-wise distribution of gram negative uropathogens



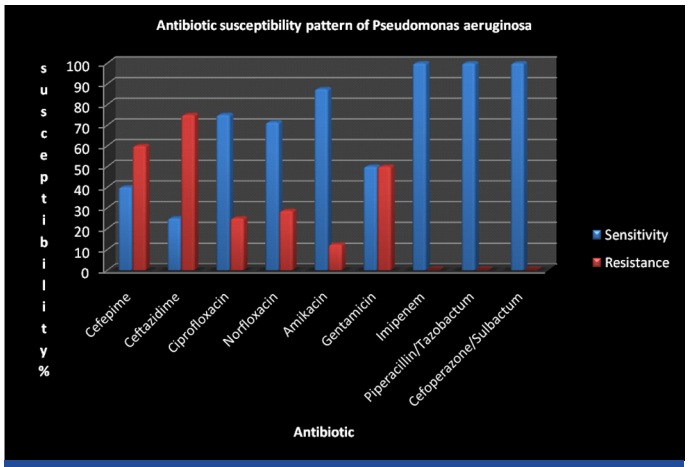
[Table/Fig-3]: Department-wise distribution of gram negative uropathogens



[Table/Fig-4]: Antibiotic sensitivity pattern among *Enterobacteriaceae*



[Table/Fig-5]: Antibiotic resistance pattern among *Enterobacteriaceae*



[Table/Fig-6]: Antibiotic susceptibility patterns of *Pseudomonas aeruginosa*

Klebsiella pneumoniae (14.87%). A majority of the culture positive isolates were obtained from the surgical departments (38.34%), followed by those from the medical departments (33.33%) and the intensive care units (25.82%).

The resistance among the uropathogens to the agents that had traditionally been recommended as the first line therapy is on the rise. The gram negative bacteria which were isolated, showed a higher resistance rate towards some of the widely used antimicrobials like cefuroxime, ceftriaxone, ciprofloxacin, norfloxacin and cotrimoxazole, as has been shown in [Table/Fig- 5 and 6]. *Pseudomonas aeruginosa* showed a relatively lesser resistance towards the flouroquinolones than *E.coli and Klebsiella*. The antibiotic sensitivity pattern of *Escherichia coli* showed a higher sensitivity towards imipenem (98.5%) followed by nitrofurantoin (98.1%) and piperacillin/tazobactam (91.5%), cefoperazone/sulbactam (86.8%) and amikacin (98.1%). Pseudomonas species and Citrobacter species showed 100% sensitivity to amikacin, imipenem, and piperacillin/tazobactam. Monotherapy with amikacin and imipenem demonstrated statistically significant susceptibility patterns and these were found to be effective against a majority of the isolates. Recently, an escalation in the drug resistance among the gram negative bacteria was observed against the 3rd generation cephalosporins and quinolones, as has been shown in [Table/Fig- 5 and 6].The organisms which belonged to the Enterobacteriaceae family showed a predominant resistance against the penicillins (amoxyclav), flouroquinolones (ciprofloxacin, norfloxacin), cephalosporins (cefuroxime, ceftriaxone), and the aminoglycosides (gentamicin).

The analysis of the age-wise data, as has been shown in [Table/Fig-2(a)] and [Table/Fig-2(b)], portrayed an increased prevalence in the 61-80 years age group (39.53%), which was at par with the findings of similar studies which were done by Manjunath G N et al., [6], Akram et al., [7] and Barate D L et al., [8]. The increased vulnerability in the geriatric population maybe due to their age related physiological and immunological changes and other co morbidities [1].

DISCUSSION

The changing trends in the aetiopathogenesis of UTIs and the emerging resistance to the antimicrobial agents are a matter of worldwide concern. Even with the adequate precautions, preventive measures and the advances in therapy, UTIs still remain the commonest infections, both in the hospitalized patients and in the out patients. This may plausibly be due to the advancing age, increase in the immunocompromised hosts, prolonged hospitalization, inadequate personal and environmental hygiene, instrumentation (catheters), co morbidities and functional or anatomical abnormalities [9]. The indiscriminate, inadequate and the irrational usage of antimicrobials has further contributed to the emergence of resistant strains, which may turn out to be a leading cause for the morbidity and mortality in the developing countries.

The present study provided an outlook on the prevalence and the antibiogram of the uropathogens which were isolated in this part of north Kerala. *E.coli* (81.80%) was the predominant organism which was isolated, followed by *Klebsiella pneumoniae* (14.87%), which was in comprehension with the findings of similar studies which were by Supriya et al., [10], Pallavi Khanna et al., [3], S Baby Padmini et al., [2], Manjunath et al., [6] and Oladeinde B.H et al., [4], as has been shown in [Table/Fig- 1(a)].

The rate of the isolation was higher in females (66.86%), thus revealing the increased susceptibility of females to UTIs than males (33.14%), as has been shown in [Table/Fig- 1(b)]., which was in concordance with the findings of similar studies which were done by Khadri et al.,[11], Oladeinde B.H et al., [4], Manjunath et al.,[6] and Barate D L et al., [8]. Females are more prone to develop UTIs, probably due to their characteristic anatomical and physiological changes - short urethra, its proximity to the anus, urethral trauma during intercourse, dilatation of the urethra and the stasis of urine during pregnancy [1,4].

The department wise isolation rate was the highest on the surgical side (general surgery, OBG, ENT etc) (38.34%), as has been shown in [Table/Fig-4], as has also been reported in similar studies. This may be due to the instrumentation, surgical procedures, obstruction to the urinary outflow and immunosuppressive drugs [3,12].

The antimicrobial resistance among uropathogens is one of the barricades that might interfere with an effective treatment. This study depicted the anti microbial susceptibility patterns among the gram negative bacteria which were isolated, as has been shown in [Table/Fig- 4 and 5]. These are of the organisms which belonged to the Enterobacteriaceae family, which showed heavy resistance towards amoxyclav (79.6%), a majority of the flouroquinolones [ciprofloxacin (62.5%) and norfloxacin (71.6%) and the cephalosporins [cefuroxime (75.9%) and ceftriaxone (71.6%)], which was in accordance with the findings of the studies which were done by Manjunath G N et al6, Khadri et al., [11], Akram et al., [7] and Barate D L et al., [8]. The reason for this might be the irrational and the prophylactic usage and the easy availability and the over the counter sale of the antimicrobials without a proper prescription and an appropriate dosing schedule. A notable observation was that a majority of the isolates showed a higher sensitivity pattern towards imipenem, piperacillin/tazobactam, and amikacin . Nitrofurantoin, with a resistance of 1.9%, was found to be an effective cure against the E.coli which induced UTIs.

Klebsiella pneumonia showed an increased resistance to amoxyclav and cefuroxime and a decreased resistance to ciprofloxacin and norfloxacin as compared to *E.coli*. However, it showed an increased resistance towards nitrofurantoin.

Pseudomonas aeruginosa showed an increased resistance towards the 3rd generation cephalosporins and a decreased resistance towards the flouroquinolones. Imipenem, piperacillin/tazobactam and cefoperazone/sulbactam with 100% sensitivity and amikacin with 87.5% sensitivity, were found to be the most effective drugs for the therapy of UTIs, as has been shown in [Table/Fig- 6].

CONCLUSION

The escalation of drug resistance among the uropathogens poses a global threat. The wide spread availability and the usage of penicillins and cotrimoxazole has led to the development of resistant strains. A disturbing fact is that even the flouroquinolones and the cephalosporins are getting exceedingly affected day by day.

Before prescribing an empirical anti microbial therapy, an in-depth knowledge of the aetiology, the predisposing factors, the cultural positivity and the continued evaluation of the susceptibility patterns of the uropathogens to the traditional as well as the new antimicrobials , is essential to avoid irrational drug usage and to ascertain the optimal prophylactic therapy.

REFERENCES

[1] Kamat US, Fereirra A, Amonkar D, Motghare DD, Kulkarni MS.

Epidemiology of the hospital acquired urinary tract infections in a medical college hospital in Goa. *IJU*. 2009; 25(1):76.
[2] Babypadmini S, Appalaraju B. Extended spectrum-lactamases in the urinary isolates of *Escherichia coli and Klebsiella pneumoniae*- the prevalence and the susceptibility patterns in a tertiary care hospital. *Indian Journal of Medical Microbiology*. 2004; 22(3):172.
[3] Pallavi K, Georgi A, Asik MA, Prathiba M, Milly M. Urinary tract infections in the era of newer immunosuppressant agents: A tertiary care center study. *Saudi Journal of Kidney Diseases and Transplantation*. 2010; 21(5): 876-80.
[4] Oladeinde BH, Omoregie R, Olley M, Anunibe JA. Urinary tract infections in a rural community of Nigeria. *North American Journal of Medical Sciences*. 2011; 3(2):75.
[5] Wilker M A CFR, Bush K, Dudley M N, et al., The Performance of Standards for Antimicrobial Disk Suspectibility Tests: Approved Standard. *Clinical and Laboratory Standards Institute.* 2009; 29(1):11-12.
[6] Manjunath G, Prakash R, Vamseedhar Annam KS. The changing trends in the spectrum of the antimicrobial drug resistance pattern of the uropathogens which were isolated from hospitals and community patients with urinary tract infections in Tumkur and Bangalore. *Int J Biol Med Re*s. 2011; 2(2):504-07.
[7] Akram M, Shahid M, Khan AU. The aetiology and the antibiotic resistance patterns of community-acquired urinary tract infections in the JNMC Hospital Aligarh, India. *Annals of clinical microbiology and antimicrobials*. 2007; 6(1):4-11.
[8] Barate D.L, Ukesh C. The bacterial profile and the antibiotic resistance pattern of urinary tract infections. *DAV International Journal of Science*. 2012; 1(1), 21-24.
[9] Davoodian P, Nematee M, Sheikhvatan M. The inappropriate use of urinary catheters and its common complications in different hospital wards. *Saudi Journal of Kidney Diseases and Transplantation*. 2012; 23(1):63.
[10] Priya P, Radha K, Jennifer G. Urinary tract infections: A retrospective survey on the causative organisms and the antibiotics which were prescribed in a tertiary care setting. *Indian Journal of Pharmacology*. 2002; 34(4):278.
[11] Khadri H, Alzohairy M. A high prevalence of multi-drug-resistance (MDR) and extended spectrum β-lactamases (ESBL) producing bacteria among community-acquired urinary tract infections (CAUTIs). *Journal of Bacteriology Research*. 2009; 1(9):105-10.
[12] Shaifali I, Gupta U, Mahmood SE, Ahmed J. The antibiotic susceptibility patterns of the urinary pathogens in female outpatients. *North American Journal of Medical Sciences*. 2012; 4(4):163.

AUTHOR(S):

1. Dr. Syed Mustaq Ahmed
2. Dr. Ramakrishna Pai Jakribettu
3. Dr. Shaniya koyakutty
4. Dr. Arya B
5. Mr. Shakir VPA

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Microbiology,
2. Assistant Professor, Department of Microbiology,
3. Tutor, Department of Microbiology,
4. Assistant Professor, Department of Microbiology,
5. Tutor, Department of Microbiology, MES Medical College, Perinthalmanna, Malappuram dist, Kerala, 679338, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Syed Mustaq Ahmed
Associate Professor, Department of Microbiology
MES Medical College,Perinthalmanna, dist
Malappuram, Kerala 679338, India.
Phone: 09846609106
E-mail: mustaq105@rediffmail.com

FINANCIAL OR OTHER COMPETING INTERESTS:

None.

Date of Submission: **May 28, 2012**
Date of Peer Review: **Jul 03, 2012**
Date of Acceptance: **Jul 12, 2012**
Date of Publishing: **Sep 30, 2012**