

CHANGING PROFILE AND INCREASING ANTIMICROBIAL RESISTANCE OF UROPATHOGENIC BACTERIA

Dr. Deepak Manthale* and Dr. C. D. Kadganchi

Department of Microbiology M.R.Medical College Kalaburagi, Karnataka.

Corresponding Author: Dr. Deepak Manthale

Department of Microbiology M.R.Medical College Kalaburagi, Karnataka.

Article Received on 03/12/2016

Article Revised on 25/12/2016

Article Accepted on 15/01/2017

Urinary tract infection (UTI) is one of the most common infections in the community practice.^[1] It ranks second amongst bacterial diseases after respiratory tract infections.^[2] Millions of people worldwide suffer from UTI every year and it is predicted that around 75% of women will suffer from UTI by the age of 24; 15-25% of this group will suffer from a relapse of the disease.^[3]

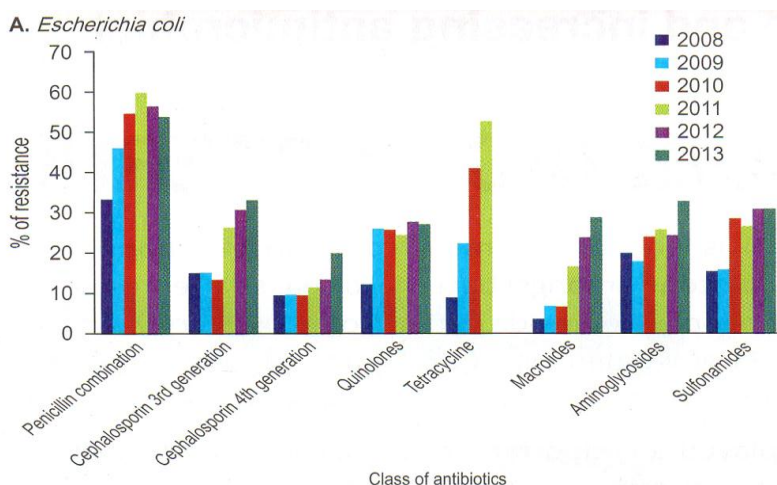
Antimicrobial agents have played an important role and reduced the incidence of morbidity and mortality associated with infectious disease. But, the pressure of using antimicrobial agents is responsible for developing emergence and spread of drug resistant strains among bacterial pathogens.^[1] The potential cause for the emergence of antibiotic resistance among several classes of bacteria is the empirical antibiotic treatment of uropathogens. Despite the clinical acceptance of empirical therapy, microorganisms are developing resistance at a faster pace than the development of new antibiotics. Misuse of antibiotics and non-compliance or incomplete course of antibiotic therapy adds to the burden of an increase in antibiotic-resistant bacteria.^[3] The antimicrobial resistance epidemiological survey on cystitis (ARESC) conducted in nine European countries and in Brazil demonstrated that *Escherichia coli* (*E. coli*) involved in uncomplicated UTIs accounted to majority of isolates and showed resistance to various antibiotics.^[4] Uropathogens have an extreme geographical variation; therefore, monitoring the susceptibility profile is essential for therapeutic orientation. This increase in

bacterial resistance to antimicrobial drugs has become noticeable and has created difficulties in controlling UTIs.²

Increasing pattern of drug resistance amongst uropathogens

Resistance pattern of bacteria responsible for UTI: An Indian scenario

Urinary tract infection (UTI) is one of the most common infectious diseases at the community level. Researchers in a study assessed the resistance pattern of bacteria responsible for UTI throughout the period of 2008-2013. Reports included patients of all age groups and both sexes. The prevalence of *E. coli* was found to be abundant with a rate of 67.1%, followed by *Klebsiella* spp. (22%) and *Pseudomonas* spp. (6%). *E. coli* was found to cause 80-90% of acute uncomplicated bacterial lower tract infections and was a predominant pathogen of bacteremic gram-negative UTI, followed by *Klebsiella pneumoniae*. The antibiotic resistance pattern for *E. coli* (Figure 1A) and *Klebsiella* spp. (Figure 1B) is shown from 2008 to 2013.^[3]



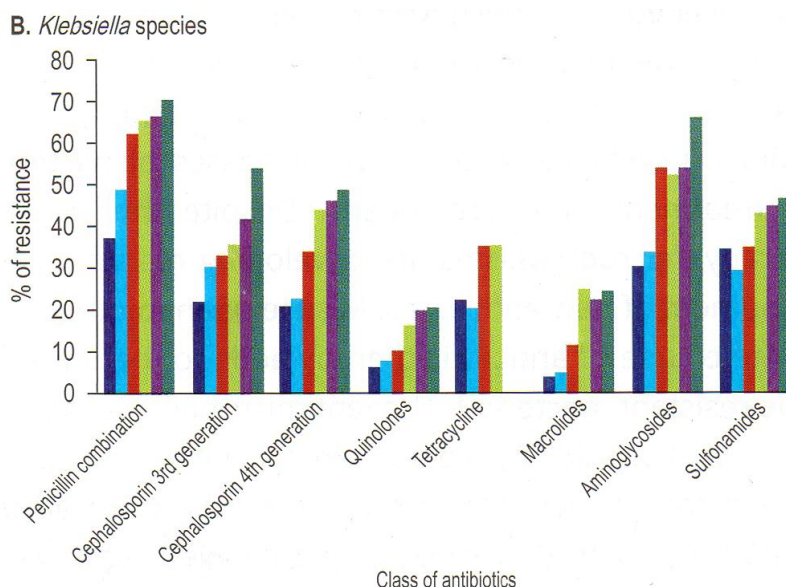


Figure 1: Antibiotic resistance pattern of *E. coli* (A) and (B) *Klebsiella* species

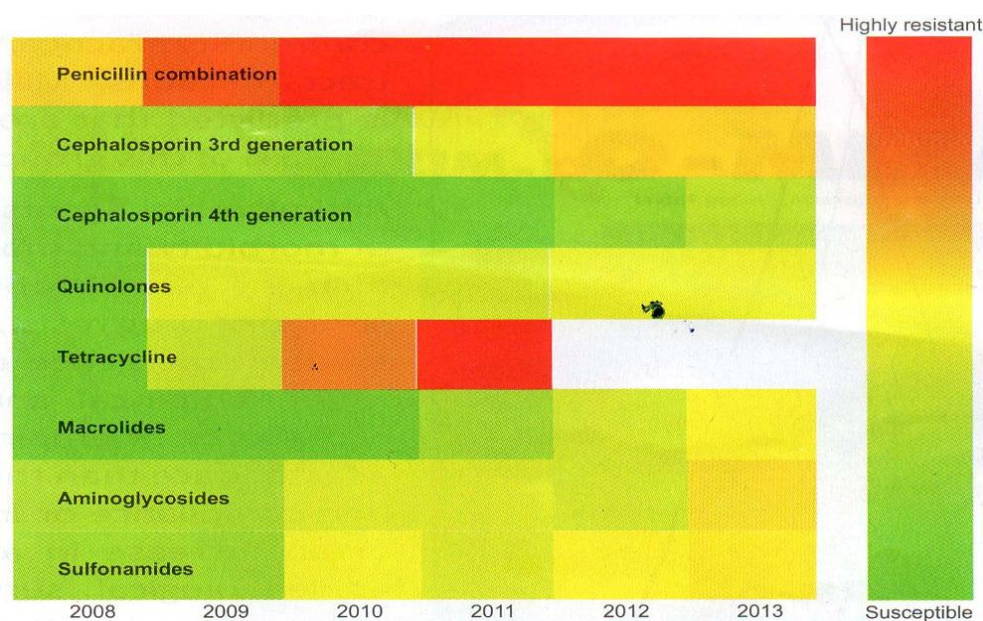
Antibiotic susceptibility to major resistant uropathogens

Sensitivity of antibiotics to the uropathogens is shown in Figure 2. The drug panel with a varying degree of therapeutic potential in the era of emerging antibiotic resistance has been demonstrated. Findings are as follows:^[3]

- Penicillin combination was found to be least effective, whereas fourth generation cephalosporin antibiotics were the most effective against uropathogens.
- Tetracycline showed a steady rise in the resistance pattern for *E. coli* and *Klebsiella* spp. and its use has been decreasing since 2010.

- Quinolones had the same efficacy for both the *E. coli* and *Klebsiella* spp. isolates from 2008 to 2013. Resistance to the penicillin combination showed a steady increase from 2008 to 2013. The rate of resistance was found to be high toward the penicillin combination and tetracycline compared to other drugs.
- Fourth generation cephalosporins were found to be the most effective of all the drugs for the resistant *E. coli* and *Klebsiella* spp. This pattern of resistance was found to be similar in other parts of the globe.

Therefore, penicillin combinations should be avoided as an empiric treatment for UTI.



Color spectrum from green to red indicates progressive increase in resistance. Green denotes susceptible; Red denotes alarmingly high degree of resistance.
 Figure 2: Antibiotic sensitivity/resistance in major uropathogens (from 2008 to 2013)^[3]

Increasing drug resistance is associated with mechanisms of drug resistance in uropathogens

Reports have suggested gram-negative bacteria such as *E. coli*, *Klebsiella* spp., *Pseudomonas* spp., and organisms from the Enterobacteriaceae group to account for more than 80% of the culture positive cases of UTIs and the rest to be caused by gram-positive cocci such as *Staphylococcus aureus* and fungi (*Candida* species).^[5]

Researchers conducted a study to obtain data on the resistance patterns of major uropathogens along with strains having resistance mechanisms of extended spectrum (3-lactamase (ESBL), AmpC beta-lactamases

and methicillin-resistant *Staphylococcus aureus* (MRSA). Clinical isolates obtained from UTI patients showed an overall prevalence of ESBL, AmpC beta-lactamases, coexisting ESBL+AmpC beta-lactamases and MRSA to be 66.9%, 21.1%, 3.5% and 42.4% respectively. *E. coli* was found to have the maximum ESBL activity, followed by *Acinetobacter* spp., *Proteus vulgaris* and *K. pneumoniae*. The maximum AmpC (3-lactamase production was found in *Providencia* spp. whereas MRSA production was maximally seen in *Staphylococcus saprophyticus* (50%) and *S. aureus* (41.4%). The prevalence of ESBL, and AmpC (3-lactamase is shown in Table 1.^[5]

Table 1. Prevalence of ESBL, AmpC (3-lactamase and co-existence of resistance (ESBL+AmpC lactamase) among gram negative bacilli in various clinical isolates^[5]

	ESBL (%)	AmpC (%)	ESBL+AmpC(%)
<i>Klebsiella</i>	13/22(59.1)	7/22 (31.8)	1/22 (4.6)
<i>Escherichia coli</i>	72/98 (73.5)	18/98(18.4)	4/98(4.1)
<i>Pseudomonas</i>	2/7 (28.6)	1/7(14.3)	0/7(0)
<i>Acinetobacter</i>	2/3 (66.7)	0/3 (0)	0/3 (0)
<i>Proteus mirabilis</i>	1/2 (50)	0/2 (0)	0/2 (0)
<i>Proteus vulgaris</i>	2/3 (66.7)	1/3(33.3)	0/3 (0)
<i>Citrobacter koseri</i>	2/4 (50)	1/4 (25)	0/4 (0)
<i>Citrobacterfreundii</i>	1/2 (50)	1/2 (50)	0/2 (0)
<i>Providencia</i>	0/1 (0)	1/1 (100)	0/1 (0)
Total	95/142 (66.9)	30/142(21.1)	5/142 (3.5)

The resistance pattern for majority of antibiotics was found to be more in the ESBL, AmpC (3-lactamase and the MRSA isolates as compared to their counterparts (non ESBL, AmpC (3-lactamase and MRSA isolates). The amoxicillin/clavulanate and ceftriaxone showed 100% resistance in the organisms producing AmpC (3-lactamase. Therefore, careful monitoring and effective infection control measures are required to prevent the rapid spread of ESBL, AmpC β -lactamase and the MRSA uropathogenic isolates.^[5]

SUMMARY

Various causes are responsible for antibiotic resistance among several classes of bacteria; such as empirical antibiotic therapy, misuse of antibiotics or incomplete course of antibiotic therapy. The prevalence of *E. coli* in UTI was found to be high followed by *Klebsiella* and *Pseudomonas* spp. The prevalence of resistant ESBL, AmpC (3-lactamase and MRSA producing uropathogen strains were found to be high. The fourth generation cephalosporins were found to be the most efficacious as compared to other antibiotics for treating UTIs and penicillin the least for major resistant uropathogens, *E. coli* and *Klebsiella* spp. Therefore, it is essential to continuously analyze the antibiotic resistance pattern in order to start the empirical therapy. This prevents the spread of resistant strains and thereby prevents treatment failure.

REFERENCES

- Haddad M. Antimicrobial resistance of uropathogens and rationale for empirical therapy in Jordan. *Biomed. & Pharmacol. J.* 2014; 7(1): 01-08.
- Moraes D, Braolos A, Borges Alves JL et al. Prevalence of uropathogens and antimicrobial susceptibility profile in outpatient from Jatai-GO. *J Bras Patol Med Lab.* 2014; 50(3): 200-4.
- Saha S, Nayak S, Bhattacharyya I, et al. Understanding the patterns of antibiotic susceptibility of bacteria causing urinary tract infection in West Bengal, India. *Front Microbiol.* 2014; 5: 463.
- Schito GC, Naber KG, Botto H, et al. The ARESC study: An international survey on the antimicrobial resistance of pathogens involved in uncomplicated urinary tract infections. *IntJ Antimicrob Agents.* 2009; 34(5): 407-13.
- Dalela G, Gupta S, Jain D et al. Antibiotic resistance pattern in uropathogens at a tertiary care hospital at Jhalawar with special reference to ESBL, AmpC β -Lactamase and MRSA production. *Journal of Clinical and Diagnostic Research.* 2012; (Suppl-2), 6(4): 645-51.