Changing Etiology of Urinary Tract Infections and Emergence of Totally Resistant Uropathogens in and around Nanded (Maharashtra) A Seven-Year Study

Bhausaheb Munde¹, Suresh Kandle², Vimal Rathod³, Vijayraj Shegokar⁴, Supriya Emekar⁵, Prerana Lahane⁶

Abstract

Background: Urinary tract infections (UTIs) remain the most common bacterial infections in developing countries. Knowledge of susceptibility pattern of uropathogens in a specific geographical location is an important factor for choosing suitable antibacterial treatment.

Objectives: A study was undertaken to ascertain the spectrum of causative agents responsible for UTIs and to determine the magnitude of drug resistance among them.

Results: A total of 1806 organisms were isolated from 3559 urine samples studied during 2010–2016. There is a shift in causative agents of UTI. Escherichia coli have been reappearing and replacing the current pathogen Klebsiella. Coagulase-positive Staphylococci have been significantly replaced by coagulase-negative Staphylococci. Other Gram-negative bacilli belonging to Proteus and Pseudomonas, which were supposed to be major pathogens of UTI particularly in tertiary care hospitals, are surprisingly being less encountered recently. It has been observed that 55.48% of strains were resistant to the antibiotics tested and there was sudden increase in incidence of totally resistant uropathogens during the year 2014. Majority of the totally resistant strains could be seen with Klebsiella (66.23%) followed by Citrobacter (63.28%).

Conclusion: These observations indicate extremely high degree of resistance in uropathogens and warrant change in the antibiotic usage as well as formulation of policy for rational use of antibiotics to reduce the emergence of drug resistance in future.

Keywords: Totally Resistant Bacteria, UTI

Introduction

Urinary tract infections (UTIs) continues to be the most common bacterial infection in medical practice today with an estimated 150 million UTIs per annum worldwide.¹ ² Escherichia coli has been recognized as the major causative agent of primary

¹Associate Professor, Dept. of Microbiology, Government Medical College, Chandrapur, Maharashtra.
²Professor and Head, ³Associate Professor, ⁴Assistant Professor, ⁵JR, Dept. of Microbiology, Dr. Shankarrao Chavan Government Medical College, Nanded.
⁶OSD, Directorate of Medical Education and Research, Mumbai.

Correspondence: Dr. Suresh Kandle, Dept. of Microbiology, Dr. Shankarrao Chavan Government Medical College, Nanded.

E-mail Id: sureshkandle3@gmail.com

Orcid Id: http://orcid.org/0000-0002-8168-3637

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UTI causing this syndrome. The etiology of UTI varies from place to place and to some extent is influenced by microbial flora prevalent in hospital environment. This study was undertaken to ascertain the spectrum of causative agents responsible for UTIs and to determine the magnitude of drug resistance in common important etiological agents.

Materials and Methods

Urine specimens were collected by conventional method from patients attending outdoor department as well as those admitted to the Dr. SC Govt. Hospital and Medical College, Nanded, from Jan. 2010 to Dec. 2016. The specimens were processed bacteriologically as per the recommended method and isolates identified on the basis of tests described elsewhere. The antibiotic susceptibility testing was done by the modified Kirby-Bauer method as described by the National Committee on Clinical Laboratory Standards (NCCLS), using standard ATCC strains as controls. The antibiotics discs and their concentrations per disc included Penicillin (10 IU/disc), Amikacin (30 μg), Gentamicin (10 μg), Erythromycin (30 μg), Norfloxacin (10 μg), Ciprofloxacin (10 μg), Cotrimoxazole (25 μg), Ofloxacin (5 μg), and Nitrofurantoin (300 μg). The source of Muller Hinton Agar (MHA) and antibiotics discs was Hi-media, India.

Result and Discussion

A total of 1806 organisms were isolated from 3559 urine samples from various patients. Of the 1806 isolates for which significant bacteriuria was demonstrated, 418 (23.14%) were E. coli and 385 (21.31%) isolated could be identified as Klebsiella species. Coagulase-negative staphylococci (CONS), Citrobacter species and coagulase-positive staphylococci (COPS) were isolated in 494 (27.35%), 207 (11.46%) and 127 (7.03%) patients respectively. Various other organisms collectively constituted 9.68% of the isolates. It has been observed that there is a changing trend in causative agent of UTI. E. coli have been re-emerging and replacing the current pathogen Klebsiella. Klebsiella was the predominant uropathogen till 2010. However from 2011, E. coli has reappeared as a major uropathogen. Similarly, COPS have been significantly replaced by CONS. Other Gram-negative bacilli belonging to genus Citrobacter, Proteus and Pseudomonas, which were supposed to be major pathogens of UTI particularly in tertiary care hospitals, are surprisingly being less encountered recently (Table 1).

| Organisms                          | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total Isolates % |
|------------------------------------|------|------|------|------|------|------|------|-----------------|
| E. coli                            | 12.55| 19.37| 19.08| 19.84| 25.51| 28.76| 32.22| 23.14%          |
| Klebsiella                         | 28.87| 20.94| 22.82| 20.63| 20.34| 19.17| 17.94| 21.31%          |
| CONS                               | 17.15| 11.51| 29.87| 30.95| 31.03| 31.84| 32.55| 27.35%          |
| COPS                               | 10.04| 7.85 | 6.22 | 5.95 | 5.86 | 8.90 | 4.98 | 7.03%           |
| Citrobacter                        | 21.75| 22.51| 11.20| 9.92 | 8.27 | 6.16 | 5.98 | 11.46%          |
| Proteus, Pseudomonas other GNB     | 9.62 | 17.80| 10.78| 12.69| 8.96 | 5.13 | 6.31 | 9.68%           |
| Total Isolates                     | 239  | 191  | 241  | 252  | 290  | 292  | 301  | 1806%           |
| Sterile                            | 220  | 160  | 196  | 204  | 236  | 233  | 245  | 1494%           |
| Insignificant Bacteriuria          | 30   | 35   | 42   | 28   | 43   | 38   | 43   | 259%            |
| Total Samples                      | 489  | 386  | 479  | 484  | 569  | 563  | 589  | 3559%           |

The last decades of 20th century withstand a sharp increase in the global incidence of severe emerging and re-emerging infectious diseases. UTIs represent considerable health problem in all age groups with higher incidence of complication among women. Almost all known bacterial pathogens have been incriminated as possible causative agents of this clinical syndrome. E. coli has been recognized as the most important single primary cause of UTI worldwide, and various studies have shown 80–85% isolation rate of this organism from the community. In patients who have been exposed to hospital environment or in whom local and general resistance has been impaired, the flora from hospital environment may be the predominant cause of UTI. In a study in USA on the important cause of nosocomial infections, E. coli, Klebsiella, COPS and Pseudomonas aeruginosa were found to be responsible for UTI in 30.7%, 8%, 1.6% and 12.7% respectively. E. coli was the commonest isolated organisms followed by Klebsiella, Proteus species and P. aeruginosa. In yet another study in Aurangabad, Klebsiella (37.35%) was the commonest isolate followed by E. coli (34.4%) and P. aeruginosa (9.64%), COPS (6.93%) and others (11.75%). These observations indicate the variable etiological pattern of UTI in different hospitals or community setting. The overwhelming preponderance of E. coli as the causative agent of UTI may be true in primary UTI. In heterogeneous population this does not seem to hold true as has been shown elsewhere as well as in our study.

It is a general practice for a microbiologist to report on multidrug-resistant strains of one or more species that are either prevalent in a hospital environment or on those isolated during a community outbreak or hospital outbreak of infection. However, prevalence of totally resistant
bacteria over a significant period is not known. It is a general trend among practitioners to prescribe newer antibiotics empirically or based on sensitivity reports because initial response to any new antibiotic is quite encouraging. But bacteria are capable of developing resistance to virtually any kind of antibiotics and initial dramatic relief provided by the newer antibiotics and the confidence of clinician to prescribe them empirically becomes more or less an illusion.

In our study, a total of 55.48% strains were resistant to the antibiotics tested (total resistance). Klebsiella species showed highest number of totally resistant strains (66.23%) followed by Citrobactor (63.28%) and E. coli (54.78%) (Table 2). It could be seen that there was sudden increase in incidence of totally resistant strains during the year 2014. Incidence of totally resistant strains was 46.07% in the year 2011 which suddenly increased to 64.82% in the year 2014, and later dropped every year to reach back to the original incidence of 51.82% in 2016. This is expected that increased usage of newer antibiotics empirically for the treatment increased the incidence of totally resistant strains in the year 2014.

Table 2. Distribution of Totally Resistant Uropathogens during 2010–2016

| Organisms                    | Total Isolates % |
|------------------------------|------------------|
|                              | 2010  | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | Total |
| E. coli                     | 50.00 | 43.24 | 45.65 | 56.00 | 68.91 | 55.95 | 52.57 | 54.78 |
| Klebsiella                  | 66.66 | 55.00 | 65.45 | 69.23 | 71.18 | 67.85 | 64.81 | 66.23 |
| CONS                        | 48.78 | 40.90 | 41.66 | 50.00 | 56.66 | 52.68 | 42.85 | 48.58 |
| COPS                        | 45.83 | 33.33 | 46.66 | 46.66 | 58.82 | 53.84 | 53.33 | 48.81 |
| Citrobacter                 | 57.69 | 55.81 | 59.25 | 72.00 | 75.00 | 72.22 | 66.66 | 63.28 |
| Proteus, Pseudomonas other GNB | 52.17 | 35.29 | 46.15 | 56.25 | 61.53 | 46.66 | 42.10 | 48.57 |
| Total Isolates              | 56.06 | 46.07 | 50.62 | 57.93 | 64.82 | 57.53 | 51.82 | 55.48 |

Irrational use of antimicrobial agents has selected various resistant organisms. This is not considered as an all-pervasive phenomenon. In the present study, the prevalence of drug resistance has been found in large number of isolates. The most important reason for failure of treatment of UTI is antimicrobial resistance in the infecting urinary tract pathogens. This is a major and increasing problem. The drugs against which antimicrobial susceptibility was ascertained in this study have been in use for many years, thus facilitating the selection and propagation of resistant strains. There is thus an urgent need to evaluate the prevalent flora against the new drugs for better management. Significant rise in drug resistant uropathogens warrants change in the antibiotic usage as well as rational use of antibiotics to reduce the emergence of drug resistance in future.

Conflict of Interest: None

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