Antimicrobial susceptibility patterns of uropathogenic *Escherichia coli* and their prevalence among people in and around Dhanbad, Jharkhand

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ABSTRACT

Background: Urinary tract infection (UTI) is one of the most common infections, which causes high morbidity and mortality among human population. The purpose of this study was to evaluate the prevalence and their antibiogram profile of uropathogenic *Escherichia coli* (UPEC) in and around Dhanbad. **Methods:** A total of 641 urine samples were collected from the suspected patients of UTI. The samples were cultured on MacConkey agar for isolation and identification. Antibiotic susceptibility test was done by disc diffusion method. Both male and female patients of different age groups were included for this study. **Results:** 45.70% urinary isolates were identified as *E. coli*. 43.56% UPEC isolates were sensitive to nitrofurantoin and piperacillin/tazobactum. 22.77% isolates were susceptible to levofloxacin and amikacin followed by cefotaxime (21.78%). These isolates were mostly resistant to ampicillin and trimethoprim/sulfamethoxazole, their susceptibility pattern was found to be 11.88% and 5.94% respectively. **Conclusion:** Prevalence of *E. coli* among urinary isolates was high in our study. Antibiogram profile of these isolates varies to different antibiotics in terms of their susceptibility pattern. Continuous surveillance of antibiogram of UPEC isolate is mandatory because it vary significantly in different geographical area. Thus empirical selection of antimicrobials should be based on the knowledge of local prevalence and individual sensitivity rather than on universal guideline.

Key words: *Antibiogram, Escherichia coli, Urinary tract infection, Uropathogenic Escherichia coli*

Urinary tract infection (UTI) is one of the most common infections, which causes high morbidity and mortality among human population [1-3]. It remains one of the most common community-acquired as well as nosocomial infections with over 150 million cases detected annually worldwide [4]. Serotypes of *Escherichia coli* consistently associated with UTI are designated as uropathogenic *E. coli* (UPEC) [3]. UPEC strains are responsible for about 90% of all community-acquired UTI and up to 50% of all nosocomial UTI [5]. *E. coli* may acquire other antibiotic resistance gene from surroundings bacteria and conversely it can spread to different potential pathogens [6]. These *E. coli* strains are often multi drug resistant, i.e., resistant to 3 or more different classes of antibiotic agents [7]. Data related to antibiotic susceptibility pattern is needed from a specified area if empirical antibiotics are to be administered in the patient suffering from UTI [8].

The present study aims at an insight in the changing scenario of the antibiotic susceptibility pattern of *E. coli*. With the rampant use (or rather misuse) of antibiotics, there is a drastic change in the susceptibility pattern. In the current scenario, it varies according to the regional and geographical location. Therefore, knowing the etiological agent and the antibiotic susceptibility pattern in an area may help the clinicians in choosing appropriate empirical antimicrobial treatment.

METHODS

Sample Collection

This study was done at Department of Microbiology at Patliputra Medical College and Hospital, Dhanbad, Jharkhand. A total of 641 urine samples were collected from the clinically suspected patient of UTI. This study was done between July-2015 and June 2016. Patients were instructed to give clean catch midstream urine in a sterile wide mouth universal sample container. Both males and females of different age groups were included in this study.

Laboratory Identification of UPEC

Urine samples were cultured on MacConkey agar with the help of a sterilized nichrome wire loop of 0.01 mm diameter. The culture plates were incubated aerobically for overnight at 37°C. The lactose-fermenting colonies were counted manually for significant bacteriuria. Suspected isolated colonies were diagnosed and characterized using microscopical (Gram-stain and motility test by hanging drop method) and biochemical tests. Biochemical tests used were: Catalase test, Indole production in peptone water, urease test on Christensen's urea agar slant, citrate utilization on

Simmon's citrate agar slant and acid/gas/H2S production in triple sugar iron agar slant.

Antibiotic Susceptibility Testing

Antibiotic susceptibility test was performed by disc diffusion method as per designed by Bauer et al. [9]. All *E. coli* isolates were tested for their antibiotic susceptibility pattern against following antimicrobials (HiMedia, Mumbai, India): Ampicillin (10 μg), ceftazidime (30 μg), levofloxacin (5 μg), nitrofurantoin (300 μg), cefotaxime (30 μg), piperacillin-Tazobactum (100/10 μg) and trimethoprim/sulfamethoxazole (1.25/23.75 μg) according to the Clinical Laboratory Standards Institute (CLSI) guidelines and interpretative criteria [10]. Bacterial suspensions were prepared in 1.0 ml of sterile peptone water. Turbidity of this suspension was adjusted to 0.5 McFarland. Plating of suspension was done on Mueller-Hinton agar plates by lawn method and then incubated at 37°C for 24 h. The inhibition zones were measured in accordance with CLSI [11]. *Pseudomonas aeruginosa* ATCC 27853 was used as a susceptible control strain while performing antimicrobial susceptibility testing [10]. extended spectrum beta lactamase testing was not done for any of these isolates.

Statistical Analysis

Categorical variables were summarized by percentages. χ^2 tests performed for trend of ordinal variable.

RESULTS

Out of 641 urine samples received during this period, only 221 samples were found positive for the bacterial growth in the culture. Among these isolates, 101 were identified as *E. coli* (45.70%). Other isolates were *P. aeruginosa* 39 (17.64%), *Klebsiella pneumoniae* 21 (9.50%), *Klebsiella oxytoca* 18 (8.14%), *Proteus vulgaris* 13 (5.88%), *Proteus mirabilis* 5 (2.26%), *Candida* spps. 17 (7.69%), *Staphylococcus saprophyticus* 7 (3.16%).

Age and Sex Predilection of UPEC

The incidence of UPEC was made according to gender and age group of the patients. Among the 101 positive growth, 39 (39.61%) were males and 62 (61.38%) females. The prevalence of *E. coli* among people was significantly higher in females than males (*P* < 0.05). People were divided into 3 groups according to their age (Table 1). Our study showed that the prevalence of UPEC was different across all age groups. It was found that the percentage of *E. coli* isolates was high in people of age groups of 16-30 years and more than 31 years of age. Statistical analysis showed that the incidence of infection with UPEC was significant (*P* < 0.05) in 16-30 years age group and more than 31 years of age group.

Table 1: Incidence of UPEC among people according to age groups and gender

Gender	Number of infected patient (%)	Age (years)		
		1-15	16-30	>31
Male	39 (38.61)	6 (15.38)	12 (30.76)	21 (53.84)
Female	62 (61.38)	10 (16.12)	28 (45.16)	24 (38.70)

UPEC: Uropathogenic *Escherichia coli*

Table 2: Antimicrobial susceptibility pattern of UPEC

Antibiotics	Number of sensitive isolates (%)
Ampicillin	12 (11.88)
Nitrofurantoin	44 (43.56)
Levofloxacin	23 (22.77)
Amikacin	23 (22.77)
Trimethoprim/sulfamethoxazole	6 (5.94%)
Cefotaxime	22 (21.78)
Piperacillin/tazobactum	44 (43.56)

UPEC: Uropathogenic *Escherichia coli*

Antibiogram

All *E. coli* (101) isolates were tested for 7 antibiotics. Their susceptibility pattern is shown in the Table 2. It was found that the most effective antibiotics for *E. coli* isolates from UTI were nitrofurantoin (43.56%) and piperacillin/tazobactum (43.56%). Levofloxacin and amikacin were exhibited equal susceptibility pattern of 22.77% followed with cefotaxime (21.78%). UPEC isolates were mostly resistant to ampicillin and trimethoprim/sulfamethoxazole, their susceptibility pattern was found to be 11.88% and 5.94% respectively.

DISCUSSION

E. coli is frequently associated with UTI and it contributes about 70-95% of all the isolates from the upper and lower UTIs [12]. The incidence of *E. coli* in our study was found to be 45.70%. In other two studies on uropathogens by Hasan et al. [13] and Aggarwal et al. [14] were observed the prevalence of *E. coli* of 50.7% and 50% respectively among Gram-negative isolates from UTI.

It is stated that UTI is predominantly a disease of the females due to a short urethra and proximity to anal opening, it makes easy for bacteria to ascend in the urinary tract [15]. In the present study, the higher rate of *E. coli* was found in females (61.38%) compared to males (39.61%). Bhattacharyya et al. were observed, *E. coli* bacteraemia is twice more common in females than males [8].

Antibiotics resistance in UPEC is of major concern globally due to its increasing resistance to several commonly prescribed antimicrobial agents [16]. In our study, UPEC isolates were various in their susceptibility to different antibiotics belonging to different groups. Ampicillin and trimethoprim/sulfamethoxazole

were relatively more resistant for UPEC, their susceptibility pattern were 11.88% and 5.94% respectively. This high resistance may be due to the spontaneous and uncontrollable use of these antibiotics [17]. Okesola and Aroundegbe in his study, found UPEC isolates were 100% resistant to cotrimoxazole and amoxicillin [18]. Piperacillin/tazobactum and nitrofurantoin were found more effective as their susceptibility pattern were higher than the other drug. Bhattacharyya et al., have also found similar observations [8]. 22.77% UPEC isolates were found susceptible to levofloxacin and amikacin in our study. Mandal et al., during his study on UTI found 73% urinary *E. coli* isolates were resistant to ciprofloxacin [19]. 21.78% of UPEC were found susceptible to 3rd generation cephalosporin (cephalosporin).

CONCLUSION

Prevalence of *E. coli* among urinary isolates was high in our study. Females were more susceptible to UTI than males. Nitrofurantoin and piperacillin/tazobactum were the most effective antibiotics for *E. coli* isolates from UTI in our study. Other commonly used antibiotics like levofloxacin, cotrimoxazole, amikacin and cefotaxime were found resistant relatively. Continuous surveillance of antibiogram profile of UPEC isolate is mandatory because it vary significantly in different geographical area. Thus empirical selection of antimicrobials should be based on the knowledge of local prevalence and individual sensitivity rather than on universal guideline.

REFERENCES

1. Rajni E, Rawat U, Malhotra VL, Mehta G. Occurence and detection of AmpC β-lactamases among clinical isolates of *Escherichia* coli and *K. pneumoniae* causing UTI. J Commun Dis. 2008;40(1):21-5.

2. Naveen R, Mathai E. Some virulence characteristics of uropathogenic *Escherichia coli* in different patient groups. Indian J Med Res. 2005;122(2):143-7.

3. Raksha R, Srinivasa H, Macaden RS. Occurrence and characterization of uropathogenic *Escherichia coli* in urinary tract infections. Indian J Med Microbiol. 2003;21(2):102-7.

4. Gonzalez CM, Schaeffer AJ. Treatment of urinary tract infection: What's old, what's new, and what works. World J Urol. 1999;17(6):372-82.

5. Foxman B. Epidemiology of urinary tract infections: Incidence, morbidity, and economic costs. Am J Med. 2002;113(1A):5-13.

6. Da Costa PM, Loureiro L, Matos AJ. Transfer of multidrug-resistant bacteria between intermingled ecological niches: The interface between humans, animals and the environment. Int J Environ Res Public Health. 2013;10(1):278-94.

7. Karlowsky JA, Kelly LJ, Thornsberry C, Jones ME, Sahm DF. Trends in antimicrobial resistance among urinary tract infection isolates of *Escherichia coli* from female outpatients in the United States. Antimicrob Agents Chemother. 2002;46(8):2540-6.

8. Bhattacharyya S, Sarfraz A, Ansari MA, Jaiswal NK. Characterization and antibiogram of uropathogenic *Escherichia coli* from a tertiary care hospital in Eastern India. Int J Curr Microbiol Appl Sci. 2015;4(2):701-5.

9. Bauer AW, Kirby WM, Sherris JC, Turck M. Antibiotic susceptibility testing by a standardized single disk method. Am J Clin Pathol. 1966;45(4):493-6.

10. CLSI. Performance Standards for Antimicrobial Susceptibility Testing; 18th Informational Supplement. CLSI document M100-S19. Wayne, PA: Clinical and Laboratory Standards Institute; 2011. CLSI. Performance Standards for Antimicrobial Susceptibility Testing; Twenty-First Informational Supplement, CLSI Document M100-S21. Wayne, PA: Clinical and Laboratory Standards Institute; 2011.

11. CLSI. Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing; 15th Informational Supplement. CLSI-NCCLS document M100-S15. Wayne, PA: Clinical and Laboratory Standards Institute; 2004.

12. Behzadi P, Behzadi E, Yazdanbod H, Aghapour R, Akbari Cheshmeh M, Salehian Omran D. A survey on urinary tract infections associated with the three most common uropathogenic bacteria. Maedica (Buchar). 2010;5(2):111-5.

13. Hasan AS, Nair D, Kaur J, Baweja G, Deb M, Aggarwal P. Resistance patterns of urinary isolates in a tertiary Indian hospital. J Ayub Med Coll Abbottabad. 2007;19(1):39-41.

14. Aggarwal R, Chaudhary U, Sikka R. Detection of extended spectrum ß-lactamase production among uropathogens. J Lab Physicians. 2009;1(1):7-10.

15. Foxman B, Brown P. Epidemiology of urinary tract infections: Transmission and risk factors, incidence, and costs. Infect Dis Clin North Am. 2003;17(2):227-41.

16. Moyo SJ, Aboud S, Kasubi M, Lyamuya EF, Maselle SY. Antimicrobial resistance among producers and non-producers of extended spectrum beta-lactamases in urinary isolates at a tertiary hospital in Tanzania. BMC Res Notes. 2010;3:348.

17. Sana T, Rami K, Racha B, Fouad D, Marcel A, Hassan M. Detection of genes TEM, OXA, SHV and CTX-M in 73 clinical isolates of *Escherichia coli* producers of extended spectrum Beta-lactamases and determination of their susceptibility to antibiotics. Int Arab J Antimicrob Agents. 2011;1(1):1-6.

18. Okesola AO, Aroundegbe TI. Antibiotic resistance pattern of uropathogenic *Escherichia coli* in South West Nigeria. Afr J Med Med Sci. 2011;40(3):235-8.

19. Mandal J, Acharya NS, Buddhapriya D, Parija SC. Antibiotic resistance pattern among common bacterial uropathogens with a special reference to ciprofloxacin resistant *Escherichia coli*. Indian J Med Res. 2012;136(5):842-9.