

Emergence of multidrug resistant uropathogenic *Escherichia coli* (UPEC) strains isolated from a hospital in Bangladesh

Md. Abdullah Yusuf*¹, KM Shahidul Islam², Sanya Tahmina Jhora³,
AKM Shamsuzzaman⁴, Md. Zakiur Rahman⁵

¹ Department of Microbiology, National Institute of Neurosciences & Hospital, Dhaka, Bangladesh. ² Department of Microbiology, Dhaka Medical College, Dhaka, Bangladesh. ³ Principal, Mugda Medical College, Dhaka, Bangladesh.

⁴ Communicable Disease Control, Directorate General of Health Sciences, Ministry of Health & Family Welfare, Dhaka, Bangladesh. ⁵ Department of Microbiology, Monno Medical College, Manikgonj, Bangladesh

Abstract

Background: Multidrug Resistant Uropathogenic *Escherichia coli* (UPEC) is becoming a global concern. Therefore, the purpose of the present study was to see the status of multidrug resistant UPEC strains.

Materials and Methods: This retrospective study was conducted at a private Hospital in Dhaka city from July 2013 to December 2013 for a period of six months. All the patients who were attended in the OPD or admitted in the IPD of the hospital presenting the clinical features of UTI at any age with both sexes were included as the study population. Patients without significant pus cell within urine, patients under antibiotic therapy or incomplete data were excluded from this study. *E. coli* was isolated and identified by standard methods and antibiotic sensitivity testing was performed by disk diffusion method.

Results: A total number of 57 UPEC were isolated of which 9 isolates were isolated from male and 48 isolates were from female. Resistant to four groups, five groups, six groups and seven groups of drugs were found in 17.5% (95% CI 7.64 to 27.36%), 14.0% (95% CI 4.99 to 23.01%), 10.5% (95% CI 2.54 to 18.46%) and 8.8% (95% CI 1.45 to 16.15%) uropathogenic *E. coli* respectively. The total number of MDR UPEC was 92.9% (95% CI 86.23 to 99.57%). In a total multidrug resistant uropathogenic *E. coli* were found in 92.9% isolates.

Conclusion: In conclusion multidrug resistant uropathogenic *E. coli* is found in a very high rate.

Key words: Multidrug resistant, uropathogenic, *Escherichia coli*, emergence, UPEC

Introduction

The uropathogenic *Escherichia coli* (UPEC) strains are responsible for 70-90% of acute cystitis (1). UPEC causes UTI in both male and female. However, it has been established that UTI is more common among women as compared to men (2).

Approximately half of all women have had a UTI by their late 20s (3). These bacteria cause significant social and economic burden to the communities and public health resources (4). The application of rational antibiotic therapy for urinary tract infections should be optimized; therefore, clinicians should be aware about the susceptibility patterns of UPEC strains according to their geographical locations or populations (5). (4-8).

***Corresponding Author:** Md. Abdullah Yusuf, Assistant Professor, Department of Microbiology, National Institute of Neurosciences & Hospital, Sher-E-Bangla Nagar, Agargaon, Dhaka-1207, Bangladesh; **E-mail:** ayusuf75@yahoo.com; Tel. no.: +8801817565830 **Received:** Jun 20, 2016. **Accepted:** Jul 30, 2016 **Published Online:** Aug 03, 2016.

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The increasing incidence of infections causes the difficulties for the proper management of UTI due to antibiotic resistant *E. coli* (6). Currently emergence of *E. coli* causing UTIs are reported which are resistant to cephalosporins, fluoroquinolones, and trimethoprim. This has created an especially clinical significant due to limited therapeutic options (7). Center for Disease Control (CDC) has published that three or more than any three groups of antibiotics which are resistant to *E. coli* is designated as multidrug resistant (MDR) *E. coli*. This group of bacteria is difficult to treat. There is no antibiotic policy in this country. This leads to the development of drug resistance to a large group of antibiotics.

Therefore, it is very important to detect these MDR UPEC isolated from both community as well as the hospital settings. The purpose of the present study was to detect the MDR UPEC isolated from a hospital in Dhaka city.

Material and methods

This retrospective study was conducted at a private multidisciplinary hospital in Dhaka city with 200 bed capacity situated at the center of the city. This study was carried out from July 2013 to December 2013 for a period of 6 (six) months. All the patients presenting the clinical features of UTI at any age with both sexes who were attended in the outdoor patient Department (OPD) or admitted in the indoor patient department (IPD) of the hospital were included as the study population. Patients without significant pus cell within urine, patients under antibiotic therapy were excluded from this study. Urine was collected in a sterile container with full aseptic precaution in a standard procedure.

E. coli was isolated and identified by standard laboratory methods by using MacConkey's agar, Cysteine Lactose Electrolyte Deficient (CLED) agar media and Kligler Iron Agar (KIA) media for biochemical test; antibiotic sensitivity testing was performed by Kirby Bauer's disk diffusion method by using 7 (seven) groups of antibiotics. The diameter of zone of inhibition was measured to interpret the sensitivity pattern according to CLSI (2016).

In this study 7 groups of antibiotics were analyzed which were quinolones, cephalosporins, aminoglycosides, macrolides, carbapenems, sulfonamides and nitrofurantoin

Statistical analysis was performed by the Statistical Program for Social Science (SPSS, Version 19.0, USA). The qualitative data were expressed in frequency and percentage and the quantitative data were expressed as mean and standard deviation. The associations of quantitative data between the two groups were performed by Student's t test. Overall resistant pattern of uropathogenic *E. coli* to different antibiotics had been calculated by multiple responses. A p value less than 0.05 has been taken as level of significance. Confidence interval was considered at the 95 % level.

Results

A total number of 57 UPEC *E. coli* was isolated and identified of which 9 (15.8%) cases were from male and the rest 48 (84.2%) cases were from female. Majority were in the age group of 20 to 60 years which was 36 (63.2%) cases followed by more than 60 years of age group which was 14 (24.6%) cases. The relationship between age group of the patients and the sex difference was statistically significant (p=0.038) (Table 1).

Table 1. Age and gender distribution of the study population (n=57).

Age Group	Sex		Total
	Male	Female	
Less than 20 Years	3(33.3%)	4(8.3%)	7(12.3%)
20 to 40 Years	1(11.1%)	17(35.4%)	18(31.6%)
40 to 60 Years	1(11.1%)	17(35.4%)	18(31.6%)
More than 60 years	4(44.4%)	10(20.8%)	14(24.6%)
Total	9(100.0%)	48(100.0%)	57(100.0%)
Mean ±SD	48.67± 30.683	44.93± 18.899	

* Student's t test has been performed to detect the level of significance; p= 0.733.

Distribution of multidrug resistant UPEC was calculated according to the number of antibiotics. It is interesting that three groups of antibiotics were resistant to 42.1% (95% CI 29.28 to 54.92%) *E. coli*. Resistant to four groups, five groups, six groups and seven groups of drugs were found in 17.5% (95% CI 7.64 to 27.36%), 14.0% (95% CI 4.99 to 23.01%), 10.5% (95% CI 2.54 to 18.46%) and 8.8% (95% CI 1.45 to 16.15%) uropathogenic *E. coli* respectively (Table 2).

Table 2. Distribution of multidrug resistant UPEC according to number of antibiotics.

Group of Antibiotics	Value	95% CI
Three groups	42.1%	29.28 to 54.92%
Four groups	17.5%	7.64 to 27.36%
Five groups	14.0%	4.99 to 23.01%
Six groups	10.5%	2.54 to 18.46%
Seven groups	8.8%	1.45 to 16.15%

*Statistical analysis was performed by multiple response; 95% CI=95% Confidence Interval.

Discussion

Urinary tract infections (UTIs) are mostly caused by *E. coli* (3). The appropriate therapy demands a current knowledge on the antimicrobial susceptibility pattern amongst these pathogens. An inappropriate use of antibiotics may lead to complications and treatment failure. The UTIs which are caused by multidrug resistant bacteria further pose a severe problem, as the treatment options are limited.

Extraintestinal pathogenic *Escherichia coli* (ExPEC) can cause various complicated diseases, like UTIs and bacteremia (8). Therefore, the emergence of multidrug resistance in *E. coli* becomes a global concern. Furthermore, the drug resistance is due to extended-spectrum β -lactamases (ESBLs) especially CTX-M family (9).

In this study a total number of 57 UPEC were isolated and identified of which 15.8% cases were from male and the rest 84.2% cases were from female. These findings indicate that the UPEC are commonly affected the women. This is in favour of the occurrence of high UTI among the female. Bashir et al. (10) have reported that female are more commonly suffering from UTI and *E. coli* is the most common pathogen. It has been established that UTI will be occurred five times among the women in their lifetime and the reasons for this are also revealed. Therefore, this statement is in consistent with the present study result.

UTI can occur at any age; however, the most common age is the reproductive age group (11). In this context the present study result shows that the majority are in the age group of 20 to 60 years which is 36 (63.2%) cases followed by more 68 than 60 years of age group which is 14 (24.6%) cases. The relationship between the age group

of the patients and the sex difference was statistically significant ($p=0.038$). Similar to the present study result Magliano et al. (12) have reported that young age group are the most vulnerable group in the causation of UTI and this group has frequently infected by different bacteria mostly gram negative.

Distribution of multidrug resistant UPEC is calculated according to number of different groups of antibiotics. The center for disease control has developed a guideline on the definition of MDR enterobacteriaceae (8). According to that guideline the present analysis has been performed. In this study there are 7 groups of antibiotics are analyzed which are quinolones, cephalosporins, aminoglycosides, macrolides, carbapenems, sulfonamides and nitrofurantoin. It is interesting that three groups of antibiotics are resistant to 42.1% (95% CI 29.28 to 54.92%) of *E. coli* which is nearly half of the uropathogenic *E. coli*. This is an alarming situation for the clinician to treat UTI patients. Delgado-Valverde et al. (11) have reported similar result regarding MDR UPEC and have mentioned that frequent uses of different antibiotic are responsible for this situation. UPEC is very important in certain dwellings, especially the people in the poor community and lack of personal hygiene; furthermore, exposure to contaminated water or soil is also an important issue (13).

UPEC are MDR in isolated *E. coli* to more than 4 groups of antibiotics. Resistant to four groups, five groups, six groups and seven groups of drugs were found in 17.5% (95% CI 7.64 to 27.36%), 14.0% (95% CI 4.99 to 23.01%), 10.5% (95% CI 2.54 to 18.46%) and 8.8% (95% CI 1.45 to 16.15%) uropathogenic *E. coli* respectively. The total number of MDR UPEC was 92.9% (95% CI 86.23 to 99.57%). Similarly Zhanel et al. (14) have done a study to find out the MDR UPEC and have found a high frequency among the urinary isolates. This result is in favour of the present study findings. There is some traditional first-line antibiotics used for treating serious infections which are caused by UPEC and these include penicillins, cephalosporins, monobactams, carbapenems, fluorquinolones as well as aminoglycosides (15). Therefore, the frequent use of these first-line agents causes the development of

resistance during the last decades which reaches a high proportion in many areas of the world (16, 17). Infections caused by multidrug-resistant UPEC increase the morbidity and mortality (18). This is mainly due to irrational use of antibiotics.

Conclusion

In conclusion, the present study permits to conclude that the multidrug resistant *E. coli* strains isolated from urinary tract infection is high. The majority of the isolates are detected from the youngest age group with the predominance of the female sex. Inappropriate use of antibiotics should be avoided by the clinician to decrease the multidrug resistance UPEC. Proper surveillance of antibiotic resistance should be carried out periodically which will give proper information for adequate and effective treatment.

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