Multidrug resistant *Escherichia coli* strains isolated from urine sample, University of Gondar Hospital, Northwest Ethiopia

Setegn Eshetie¹, Fentahun Tarekegn², Gemechu Kumera³, Feleke Mekonnen⁴

¹Department of Medical Microbiology, School of Biomedical and Laboratory Sciences, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia

²Department of Anesthesia, College of Medicine and Health Sciences, Debre Tabor University, Debre Tabor, Ethiopia

³Department of Public health, College of Medicine and Health Sciences, Debre Markos University, Debre Markos, Ethiopia

⁴Management Science for Health (MSH), Help Ethiopia Address the Low TB Performance, Finote Selam, Ethiopia

**ARTICLE INFO**

**ABSTRACT**

**Objective:** To assess multidrug resistant (MDR) *Escherichia coli* (*E. coli*) isolates from patients with urinary tract infection.

**Methods:** From February to June 2014, a cross sectional study was conducted among urinary tract infection patients at the University of Gondar Hospital. Culture and disk diffusion method were used for *E. coli* isolation and to determine the antibiotic susceptibility patterns. Data were entered and analyzed using SPSS version 20. *P* < 0.05 was considered as statistically significant.

**Results:** A total of 112 *E. coli* isolates were identified and the rate of isolation was higher among female participants (28.7%; *P* = 0.03). Of the isolates, 104 (92.9%) were MDR *E. coli*; and the isolates showed high resistance rates towards ampicillin (99%), cotrimoxazole (69%), chloramphenicol (58.7%), gentamycin (56.7%) and ceftazidime (55.8%). However, comparative isolates showed low resistance rates to ciprofloxacin (1%), cefepime (8.7%), and ceftriaxone (11.5%). Moreover, resistance rates of MDR *E. coli* isolates were significantly higher than non-MDR strains for ceftazidime (55.8% versus 12.5%; *P* = 0.015), and ampicillin (99% versus 87.5%; *P* = 0.018).

**Conclusions:** High prevalence of MDR *E. coli* isolates was observed in this study. Regular monitoring of antibiotic resistance rates is necessarily required to improve and revise empirical antibiotic therapy protocols.

---

1. Introduction

Urinary tract infections (UTIs) are one of the most common clinical problems for consultation and antibiotic prescription and often associated with significant morbidity and mortality worldwide[1]. Excessive and/or inappropriate use of antibiotics in treating UTIs in developing countries, including Ethiopia becomes a major problem, which are responsible for the emergence and spread of multidrug resistant (MDR) urinary bacteria[2,3]. Gram negative bacteria, especially *Escherichia coli* (*E. coli*) is the most prevailing cause of both community and hospital acquired UTIs. UTIs caused by MDR *E. coli* isolates are a major public health issue, since the efficacy of many antimicrobial agents has been compromised, thus reducing the therapeutic options significantly and making the provision of an appropriate antimicrobial therapy more challenging[4,5].

Updated knowledge of the burden of the causal bacteria and its antimicrobial susceptibility pattern are substantial for proper antibiotic selection and appropriate therapy. Since those groups of bacteria are the main cause of UTIs and possess several mechanisms to diminish the efficacy of currently available antibiotics, the aim of the present study was to assess the prevalence of MDR *E. coli* among patients with UTI.
2. Materials and methods

2.1. Bacterial isolates

A total of 112 non-duplicate E. coli uropathogens were collected from Gondar Hospital from February to May 2014. Antibiotic susceptibility testing was done by Kirby-Bauer disk diffusion test method on Muller-Hinton agar plate and interpreted according to Clinical Laboratory and Standards Institute guidelines, where the following antibiotics (from Oxoid, England) were tested: cefotaxime (CTX; 30 µg), ceftiraxone (CTR; 30 µg), cefepime (CPM; 30 µg), cefazidine (CAZ; 30 µg), cefpodoxime (CPD; 30 µg), ciprofloxacin (CIP; 5 µg), tetracycline (TE; 30 µg), chloramphenicol (C; 30 µg), amoxicillin-clavulanic acid (AMC; 30 µg), nalidixic acid (NA; 30 µg), gentamicin (GEN; 10 µg), ampicillin (AMP; 10 µg) and trimethoprim-sulfamethoxazole (SXT; 25 µg). Quality control was performed using E. coli ATCC 25922. An isolate was considered MDR if it was resistant to at least two of the antibiotic agents tested from different classes of antimicrobials[6,7].

2.2. Ethical clearance

This study was started after approved by the Research and Ethics Committee of School of Biomedical Laboratory Sciences and informed consent was obtained from each subject.

2.3. Statistical analysis

Data were analyzed using SPSS version 20 software. Associations were measured using Chi-square test. P-values < 0.05 were considered as statistically significant.

3. Results

3.1. Prevalence and antibiotic resistance pattern of MDR E. coli

One hundred and twelve E. coli isolates were identified from 112 (25.3%) patients. The isolates were tested for antimicrobial susceptibility and 104 (92.9%, 95% confidence interval: 87.3%–97.4%) of them showed resistance to two or more antibiotics. Among MDR strains, only 5 (4.8%) isolates were resistant to 3 antibiotics, and the rest 99 (95.2%) were resistant to four and more antibiotics (Table 1).

Table 1

| Antibiotic resistance phenotype | No of strains |
|---------------------------------|---------------|
| AMP, AMC, NA                    | 5 (4.8)       |
| AMP, SXT, AMC, CPD              | 28 (26.9)     |
| AMP, C, GEN, CAZ, CTX           | 24 (23.1)     |
| AMP, SXT, C, GEN, CAZ, TE       | 32 (30.8)     |
| AMP, SXT, TE, AMC, CPD, NA, CTR | 9 (8.7)       |
| AMP, C, TE, AMC, CPD, NA, CPM, CTR/GEN | 4 (3.8) |
| AMP/CIP, C, TE, AMC, CPD, NA, CPM, GEN, CAZ | 2 (1.9) |

The overall resistance profile of E. coli isolates are shown in Figure 1. High resistance rate was observed to AMP (98.2%) followed by SXT (64.3%), and C (54.5%). Comparatively, it showed low resistance rate to CIP (0.9%), CPM (8%), and CTR (10.7%).

Figure 1. Resistance rate of E. coli isolates from UTI patients.

3.2. Resistance rates of MDR E. coli versus non-MDR E. coli

Additionally, the resistance rates of MDR E. coli versus non-MDR E. coli were presented in Table 2. The overall antibiotic resistance rates of MDR E. coli isolates were significantly higher than non-MDR strains for CAZ (55.8% versus 12.5%; P = 0.015), and AMP (99.0% versus 87.5%; P = 0.018). On the other hand, no antibiotic resistance pattern was observed among non-MDR E. coli strains for the rest of antibiotics.

Table 2

| Antibiotics | MDR E. coli isolates (n = 104) | Non-MDR E. coli isolates (n = 8) | P value |
|-------------|--------------------------------|---------------------------------|---------|
| CTX         | 24 (23.1%)                     | 0                               | -       |
| CAZ         | 58 (55.8%)                     | 1 (12.5%)                       | 0.015   |
| CTR         | 12 (11.5%)                     | 0                               | -       |
| CPD         | 43 (41.3%)                     | 0                               | -       |
| CPM         | 9 (8.7%)                       | 0                               | -       |
| CIP         | 1 (1.0%)                       | 0                               | -       |
| SXT         | 72 (69.0%)                     | 0                               | -       |
| TE          | 49 (47.0%)                     | 0                               | -       |
| C           | 61 (58.7%)                     | 0                               | -       |
| AMP         | 103 (99.0%)                    | 7 (87.5%)                       | 0.018   |
| NA          | 19 (18.3%)                     | 0                               | -       |
| GE          | 59 (56.7%)                     | 0                               | -       |
| AMC         | 47 (45.2%)                     | 0                               | -       |

4. Discussion

The threat of antibiotic resistance becomes a prime public health issue in developing countries, notably Ethiopia. Thus, according to a finding, many factors are contributing to high rates of bacterial antibiotic resistance, such as misuse/overuse of antibiotics by healthcare professional and general public, inadequate surveillance systems due to lack of reliable microbiological techniques leading to inappropriate prescription of antibiotics[2,3].

Likewise, the present study also demonstrates the problem of antibiotic resistance in E. coli isolates. Specifically, it showed that high prevalence of MDR E. coli isolates identified from patients with UTI was 92.9% (95% confidence interval: 87.3%–97.7%). The rate of MDR E. coli demonstrated in this study was much higher than findings from developed countries[8-10], but comparable to published
data from low income countries[4,5,11,12]. However, few reports from developing countries documented lower prevalence of MDR E. coli as compared to this study[13-16]. We hypothesized, the variation could be due to difference in geographical location, study period, study population and employed standard methods for each study.

Many of research findings revealed that antibiotic resistance becomes increased in alarming pace with function of time[2,17,18]. For instance, according to report from Gondar in 2002, the prevalence of MDR E. coli was 65.4%(19). However, in our study the situation becomes escalated to 92.9%. Besides, with reference to previous reports, E. coli isolates were found to be highly resistant to commonly prescribed antibiotics, such as AMP, cotrimoxazole, C, GEN, and CTZ(20-23), which shows an agreement with the results reported in this study. Therefore, these antibiotics should not be recommended as a first line to treat UTIs. On the other hand, CIP demonstrated a high level of in vitro susceptibility, which are in line with other findings[11,15,19,24], and could be considered as drugs of preference to treat bacterial uropathogens.

In conclusion, high rates of antibiotic resistance were observed among E. coli isolates for commonly prescribed antibiotics. Moreover, high numbers of MDR E. coli isolates gave rise to concern. Regular monitoring of antimicrobial drug resistance seems necessary to improve standard guidelines for empirical antibiotic therapy.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgments

We wish to acknowledge the contribution of the study participants and School of Biomedical and Laboratory Sciences (University of Gondar) for providing necessary materials and resources.

References

[1] Barber AE, Norton JP, Spivak AM, Mulvey MA. Urinary tract infections: current and emerging management strategies. Clin Infect Dis 2013; 57(5): 719-24.

[2] Sosa AJ, Byarugaba DK, Amabile C, Hseuh PR, Kariuki S, Okike IN. Antimicrobial resistance in developing countries. New York: Springer; 2010.

[3] World Health Organization. Antimicrobial resistance. Geneva: World Health Organization; 2015. [Online] Available from: http://www.who.int/mediacentre/factsheets/fs194/en/ [Accessed on 25th, November, 2015]

[4] Ibrahim ME, Bilal NE, Hamid ME. Increased multi-drug resistant Escherichia coli from hospitals in Khartoum state, Sudan. Afr Health Sci 2012; 12(3): 368-75.

[5] Sabir S, Ahmad Anjum A, Ijaz T, Asad Ali M, Ur Rehman Khan M, Nawaz M. Isolation and antibiotic susceptibility of E. coli from urinary tract infections in a tertiary care hospital. Pak J Med Sci 2014; 30(2): 389-92.

[6] Chesbrough M. Manual of medical microbiology. Britain: Oxford Press; 2000.

[7] Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing: twenty-first informational supplement. Wayne: Clinical and Laboratory Standards Institute; 2012. [Online] Available from: http://antimicrobians.com.ar/ATB/wp-content/uploads/2012/11/M100S22E.pdf [Accessed on 25th, November, 2015]

[8] Santo E, Salvador MM, Marin JM. Multidrug-resistant urinary tract isolates of Escherichia coli from Ribeirao Preto, Sao Paulo, Brazil. Braz J Infect Dis 2007; 11(6): 575-8.

[9] Khawcharoenporn T, Vasoo S, Singh K. Urinary tract infections due to multidrug-resistant enterobacteriaceae: prevalence and risk factors in a Chicago emergency department. Emerg Med Int 2013; 2013: 258517.

[10] Sahm DF, Thorsson C, Mayfield DC, Jones ME, Karlowsky JA. Multidrug-resistant urinary tract isolates of Escherichia coli; prevalence and patient demographics in the United States in 2000. Antimicrob Agents Chemother 2001; 45(5): 1402-6.

[11] Alemu A, Dagnew M, Alem M, Gizachew M. Uropathogenic bacterial isolates and their antimicrobial susceptibility patterns among HIV/ AIDS patients attending Gondar University specialized hospital Gondar, Northwest Ethiopia. J Microbiol Res Rev 2013; 1(4): 42-51.

[12] Sharma AR, Bhatta DR, Shresta J, Banjara MR. Antimicrobial susceptibility pattern of Escherichia coli isolated from urinary tract infected patients attending Bir Hospital. Nepal J Sci Technol 2013; 14(1): 177-84.

[13] Basal P, Neupane S, Marasini BP, Ghimire KR, Lekhak B, Shresta B. High prevalence of multidrug resistance in bacterial uropathogens from Kathmandu, Nepal. BMC Res Notes 2012; 5: 38.

[14] Laghari AH, Shah AM. Multiple drug resistant (MDR) strains of Escherichia coli isolated from urinary tract infection, a predictor of female childhood protein deficiency in Southern Sindh, Pakistan. Pak J Nat 2012; 11(1): 47-50.

[15] Iqbal M, Patel IK, Shah SH, Ain Q, Barney N, Kiani Q, et al. Susceptibility patterns of Escherichia coli: prevalence of multidrug-resistant isolates and extended spectrum beta-lactamase phenotype. J Pak Med Assoc 2002; 52: 407-11.

[16] Mehta M, Bhardwaj S, Sharma J. Prevalence and antibiotic susceptibility pattern of multi-drug resistant Escherichia coli isolates from urinary tract infection (UTI) patients. Int J Life Pharm Res 2012; 2: 6-11.

[17] D’Agata EM. Rapidly rising prevalence of nosocomial multidrug-resistant, Gram-negative bacilli: a 9-year surveillance study. Infect Control Hosp Epidemiol 2004; 25(10): 842-6.

[18] Dromigny JA, Nabeth P, Juergens-Behr A, Perrier-Gros-Claude JD. Risk factors for antibiotic-resistant Escherichia coli isolated from community-acquired urinary tract infections in Dakar, Senegal. J Antimicrob Chemother 2005; 56(1): 236-9.

[19] Moges F, Mengistu G, Genetu A. Multiple drug resistance in Urinary pathogens at Gondar College of Medical science hospital, Ethiopia. East Afr Med J 2002; 79(8): 415-20.

[20] Yismaw G, Asrat D, Woldeamanuel Y, Unakal CG. Urinary tract infection: bacterial etiologies, drug resistance profile and associated risk factors in diabetic patients. Eur J Exp Biol 2012; 2(4): 889-98.

[21] Tiruneh M, Yifru S, Gizachew M, Molla K, Belyahun Y, Moges F, et al. Changing trends in prevalence and antibiotics resistance of uropathogens in patients attending the Gondar University Hospital, Northwest Ethiopia. Int J Bacteriol 2014; 2014: 629424.

[22] Gizachew M, Kebede M, Merid Y, Sinshaw Y, Tiruneh M, Alemayehu M, et al. Escherichia coli isolated from patients suspected for urinary tract infections in Hawassa Referral Hospital, Southern Ethiopia: an institution based cross sectional study. J Microbiol Res 2013; 1: 9-15.

[23] Farshad S, Ranjar R, Anvarinejad M, Shahidi MA, Hosseini M. Emergence of multi drug resistant strains of Escherichia coli isolated from urinary tract infection. Open Conf Proc J 2010; 1: 192-6.

[24] Kibret M, Abera B. Antimicrobial susceptibility patterns of E. coli from clinical sources in Northeast Ethiopia. Afr Health Sci 2011; 11: S40-5.