Detection of Aminoglycosides Resistance among Strains of *Escherichia Coli* Isolated From Patients with Urinary Tract Infection

Waseem Sameer Kwami¹, Ruaa Abdalghafour Dahab¹, Ayaat Badawi Merghani¹, Ruaa Hannan Gad-Alseed¹, Mosab Nouraldein Mohammed Hamad²

¹Microbiology Department, Faculty of Medical laboratory Science, Shendi University Sudan  
²Phylum of Medical Parasitology, Medical Laboratory Sciences Department, Faculty of Health Science, Elsheikh Abdallah Elbadri University, Berber, Sudan

*Corresponding Author*  
Mosab Nouraldein Mohammed Hamad

**Abstract:** Background: Urinary tract infections attack about 150 million people each year globally and nowadays there is a high emergence of antibiotic resistance strains among *E. Coli* species that cause UTI. The objective of this study was to detect Aminoglycosides resistance among *E. Coli* strains isolated from patients with urinary tract infection.  

**Method:** A total of 70 urine specimens were collected from patient with symptoms of urinary tract infection in sterile urine containers, and then inoculated in CLED media, incubated at 37c for 24 hours. *E. Coli* species were identified according to their colonial morphology, indirect gram staining reaction, and biochemical tests. Identified species were tested for antimicrobial susceptibility against the following aminoglycosides: Amikacin, Kanamycin, Streptomycin, Gentamicin, and Tobramycin using Kirby-bauer disc diffusion method. **Results:** The study revealed that 55.7% of urinary tract infections were caused by *E. Coli*. The study also showed that 12.8% of isolated *E. Coli* species were resistant to Amikacin, 28.2% to Gentamicin, 43.6% to Streptomycin, 48.7% to Kanamycin, and 53.8% to Tobramycin. **Conclusion:** The study concluded that the overall resistance of isolated *E. coli* species to aminoglycosides was 37.4% the most powerful Aminoglycoside against *E. Coli* species was Amikacin.  

**Keywords:** Aminoglycosides, resistance, Escherichia coli, UTI.

**INTRODUCTION**  
Urinary tract infections (UTIs) are among the most common types of bacterial infection acquired both from the community and nosocomial. There are two types of UTI: hospital associated urinary tract infection (HAUTIs), and community-associated urinary tract infection (CAUTIs).Women are the predominant group of the patients with CAUTIs [1]. UTIs were estimated to represent 100,000 hospitalizations, 7 million visits and 1 million admissions to emergency services in USA. The economic and public health loads of UTIs is radical and markedly affect the quality of life of infected patients [2].

The plurality of UTIs are caused by *E. coli* bacteria followed by *proteus* and other *Enterobacteriaceae*. However, among bacteria causing UTIs, *E. Coli* is considered as the most dominant cause of both community and hospital acquired UTIs. Because *E. Coli* accounts for up to 80% of community-acquired uncomplicated UTIs, these bacteria should be targeted when choosing experimental antibiotics [3].

Antibiotics commonly recommended for treatment of UTIs include co-trimoxazole, Nitrofurantoin, Ciprofloxacin and Ampicillin. How-ever there is worldwide increase in antibiotic resistance among urinary tract pathogens which limit treatment options. The Aminoglycosides are strong bactericidal agents that inhibit bacterial protein synthesis by joining to the 30S ribosomal subunit. They are often used in combination with either a b-lactam or a glycopeptides, particularly in the treatment of *E. colii* UTI, as these drugs act synergically [4].
The application may be limited by occurrence of resistant strains in treatment. Various mechanisms are playing a role in the development of Aminoglycoside resistance but the existence of Aminoglycoside of modifying enzymes is the most clinical and epidemiological value. Antimicrobial resistance of urinary pathogens is increasing globally. Antibiotic resistance analysis showed among 276 E. coli isolated from clinical specimens, 39% of isolates were found to be resistant to most popular antibiotics [5].

Other study showed that out of 247 E. coli isolates about 82 % of isolates were found to be resistant to numerous antibiotics [6]. Therefore the current study is conducted to detect the percentage of resistant of E. coli strains that causes UTI to selected aminoglycosides.

METHOD

Specimen and sample processing

A total of 70 urine specimens were collected consecutively from in and out-patients at Shendi Teaching Hospital and AlmakNimer University Hospital, Shendi, Sudan. The collection was done by trained medical personnel avoiding contamination. Clean-catch mid-stream urine samples were collected from consenting patients. The specimens were immediately transported to the laboratory after collection and processed. All contaminated urine specimens and all patients refused to fill the consent form were excluded from the study [7].

Isolation and identification

A loop-full (0.001 ml) of well mixed uncentrifuged urine was streaked onto the surface CLED agar. The plates were incubated aerobically at 370 C for 18-24 hours and counts were expressed in colony forming units (CFU) per milliliter (mL). A count of 10[5] CFU/MI or more was considered significant bacteruria. E.coli species were identified based on colonial morphology, indirect gram staining reaction, and biochemical tests [8].

Antimicrobial susceptibility testing

This was done using the Kirby Bauer Disc diffusion method with reference to the Clinical Laboratory Standard Institute (CLSI) performance guideline for antimicrobial susceptibility testing. Quality was assured by testing the E. coli quality control strain, ATCC 25922, in every batch. All zones of inhibition determined were within the ranges prescribed by the CLSI. Five aminogycosides were applied; Tobramycin 10mg, Kanamycin 30mg, Streptomycin 10 mg, Gentamicin 10mg, and Amikacin 30mg [9].

RESULTS

This study was conducted in Shendi town, River Nile state to detect Aminoglycosides resistance among E. coli species isolated from patients with urinary tract infection. In this study a total of (70) participants were included the majority of them (84.3%) were females and (15.7%) were males (Table 1). Their age ranged from (4) to (67) years, more than 41% were within the age group (31-60 years) (Table 2). In this study E. coli was the most frequent isolated pathogen among UTI patients (55.7%) (Table 3).

The study revealed that the resistance of isolated E. coli species to Aminoglycosides was: 53.8% to Tobramycin, 48.7% to Kanamycin, 43.6% to Streptomycin, 28.2% to Gentamicin, and 12.8% to Amikacin. The isolated species of E. coli showhighest resistance to Tobramycin and the lowest resistance level was detected against Amikacin. The study also revealed that the overall resistance of isolated E. coli species to aminoglycosides was 37.4 % (Table 4).

| Gender | Number | Percent (%) |
|--------|--------|-------------|
| Male   | 11     | 15.7%       |
| Female | 59     | 84.3%       |
| Total  | 70     | 100%        |

| Age group (years) | Number | Percent (%) |
|-------------------|--------|-------------|
| 1-30              | 18     | 25.7%       |
| 31-60             | 29     | 41.4%       |
| Above 60          | 23     | 32.9%       |

Table-1: Shows distribution of study population according to gender

Table-2: Shows distribution of study population according to age
### Table-3: Shows the Percentage of UTI caused by E. coli:

| Causative agent | Number | Percent (%) |
|-----------------|--------|-------------|
| E. Coli         | 39     | 55.7%       |
| Others          | 31     | 44.3%       |
| Total           | 70     | 100%        |

### Table-4: Shows the resistance of E. coli to selected Aminoglycosides

| Pattern | Tobramycin | Gentamicin | Streptomycin | Amikacin | Kanamycin | Total |
|---------|------------|------------|--------------|----------|-----------|-------|
|         | No %       | No %       | No %         | No %     | No %      | No %  |
| Sensitive | 18 46.2%   | 28 71.8%   | 22 56.4%     | 34 87.2% | 20 51.3%  | 122 62.6%       |
| Resistant | 21 53.8%   | 11 28.2%   | 17 43.6%     | 5 12.8%  | 19 48.7%  | 73 37.4%        |
| Total    | 39 100%    | 39 100%    | 39 100%      | 39 100%  | 39 100%   | 195 100%        |

**DISCUSSION**

This study was conducted to detect Aminoglycosides resistance in E. coli isolated from patients with urinary tract infection.

The study shows that the infection was highest in females with 84.3% as compared to 15.7 in men. This is in similar to previous studies conducted by Dason et al. which showed that the UTI was more commonly occurred in women than men [10].

The prevalence of bacterial UTI was highest in the age group 31-60 years (41.4%); this finding was disagreed with results obtained by Martin Odoki et al. in Uganda, who reported that the prevalence was highest in 20-29 age groups. This difference may be due to that in our own study we collect most samples from pregnant UTI patients whomainly found in this age group [11].

In this study E. coli was the most predominant causative agent which was responsible of (55.7%) of urinary tract infections, This finding is in agreement with result obtained by Devanand P. and Ramchandra S. who indicated the same result [12].

The study showed that the resistance of E. coli to Amikacin was (12.8%), Gentamicin (28.2%), Tobramycin (53.8%), this result different from other result obtained by Helio et al. who reported that resistance of E. coli to the same antibiotic was (0.4%), (6.5%), (6.5%) respectively[13].

Also the study denoted that the resistance of isolated E.coli species to streptomycin was (43.6%), and to Kanamycin (48.7%), and this disagreed with result of Sumera et al. who showed that the resistance of E. coli to streptomycin (30%), and to Kanamycin (19.9%). This difference of findings may be attributed to the difference in the period between the two studies, in which the less resistance level was detected in the studies conducted in time earlier than this current recent study, and this may be justified by distribution of the resistant strains of E. coli among patient either due to bad community practices or deficient in implementation of infection control guidelines in hospital and health care facilitates [14].

The study revealed that the resistance of E. coli to Aminoglycosides was (37.4%), this finding is in difference with result obtained in America by Michael et al. who reported that the percentage of resistance in E. coli species to Aminoglycosides was (0%); this difference may be attributed to misuse of antibiotics which defined as the use of a substance for a purpose not consistent with legal or medical guidelines, and overuse which means taking a larger dose than you are supposed to. These bad habits in our country result in an increased risk of antibiotic resistance [15].

**CONCLUSION AND RECOMMENDATIONS**

The research established that the total resistance of isolated E. coli species to aminoglycosides between the participants was 37.4% the most influential Aminoglycoside against E. Coli was Amikacin. Further studies are recommended with large sample size.

**REFERENCES**

1. Car, J. (2006). Urinary tract infections in women: diagnosis and management in primary care. *Bmj*, 332(7533), 94-97.
2. Kostakioti, M., Hultgren, S. J., & Hadjifrangiskou, M. (2012). Molecular blueprint of uropathogenic Escherichia coli virulence provides clues toward the development of anti-virulence therapeutics. *Virulence*, 3(7), 592-593.

© South Asian Research Publication, Bangladesh

Journal Homepage: http://sarpublication.com
3. Kang, C. I., Kim, J., Park, D. W., Kim, B. N., Ha, U., Lee, S. J., ... & Wie, S. H. (2018). Clinical practice guidelines for the antibiotic treatment of community-acquired urinary tract infections. *Infection & chemotherapy*, 50(1), 67-100.

4. Schmitz, F. J., & Jones, M. E. (1997). Antibiotics for treatment of infections caused by MRSA and elimination of MRSA carriage. What are the choices? *International journal of antimicrobial agents*, 9(1), 1-19.

5. Soleimani, N., Aganj, M., Ali, L., Shokoohizadeh, L., & Sakinc, T. (2014). Frequency distribution of genes encoding aminoglycoside modifying enzymes in uropathogenic E. coli isolated from Iranian hospital. *BMC research notes*, 7(1), 842.

6. Ibacache-Quiroga, C., Oliveros, J. C., Couce, A., & Blázquez, J. (2018). Parallel evolution of high-level aminoglycoside resistance in Escherichia coli under low and high mutation supply rates. *Frontiers in microbiology*, 9, 427.

7. Ouslander, J. G., Schapira, M., & Schnelle, J. F. (1995). Urine specimen collection from incontinent female nursing home residents. *Journal of the American Geriatrics Society*, 43(3), 279-281.

8. Heuck, C. (1999). District Laboratory Practice in Tropical Countries. *Bulletin of the World Health Organization*, 77(1), 96-96.

9. Harding, G. K., Zhanel, G. G., Nicolle, L. E., & Cheang, M. (2002). Antimicrobial treatment in diabetic women with asymptomatic bacteriuria. *New England Journal of Medicine*, 347(20), 1576-1583.

10. Dason, S., Dason, J. T., & Kapoor, A. (2011). Guidelines for the diagnosis and management of recurrent urinary tract infection in women. *Canadian Urological Association Journal*, 5(5), 316.

11. Odoki, M., Almustapha Aliero, A., Tibyangye, J., Nyabayo Maniga, J., Wamponde, E., Drago Kato, C., ... & Bazira, J. (2019). Prevalence of bacterial urinary tract infections and associated factors among patients attending hospitals in Bushenyi district, Uganda. *International journal of microbiology*, 2019.

12. Prakash, D., & Saxena, R. S. (2013). Distribution and antimicrobial susceptibility pattern of bacterial pathogens causing urinary tract infection in urban community of Meerut city, India. *International Scholarly Research Notices*, 2013.

13. Sader, H. S., Jones, R. N., Winokur, P. L., Pfaffer, M. A., Doern, G. V., Barrett, T., ... & SENTRY Study Group. (1999). Antimicrobial susceptibility of bacteria causing urinary tract infections in Latin American hospitals: results from the SENTRY Antimicrobial Surveillance Program (1997). *Clinical Microbiology and infection*, 5(8), 478-487.

14. Sabir, S., Anjum, A. A., Ijaz, T., & Ali, M. A. (2014). Isolation and antibiotic susceptibility of E. coli from urinary tract infections in a tertiary care hospital. *Pakistan journal of medical sciences*, 30(2), 389.

15. Goodlet, K. J., Benhalima, F. Z., & Nailor, M. D. (2019). A systematic review of single-dose aminoglycoside therapy for urinary tract infection: is it time to resurrect an old strategy?. *Antimicrobial agents and chemotherapy*, 63(1).