ECRONICON OPEN ACCESS

EC PHARMACOLOGY AND TOXICOLOGY

Research Article

Prevalence of Multidrug Resistant Uropathogenic Bacteria in a Major Hospital in Khartoum, Sudan

Khairy M Ali[1]*, Ibrahim T Khalil[2], Abdallah A Elhussien[2], Areej M Ali[3] and Elsaddig A Hag[2]

[1]*Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, International University of Africa, Khartoum State, Sudan*

[2]*Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, Elrazi University, Khartoum State, Sudan*

[3]*Faculty of Medicine, Nahda College, Khartoum, Sudan*

***Corresponding Author:** Khairy M Ali, Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, International University of Africa, Khartoum State, Sudan.

Received: November 22, 2022; **Published:** December 28, 2022

Abstract

Introduction: Urinary tract infection (UTI) is the presence of multiplying bacteria within the urinary tract with a threshold number of pathogenic bacteria (10^5 CFU/mL) in urine. Despite the presence of different host defense mechanisms against microbial infection in urinary tract [1].

Methodology: A retrospective record review of culture results of all types of wound swabs referred to this private major hospital from 1 June 2020 to 31 December 2020 was conducted. The hospital is considered one of the few hospitals in Khartoum that conduct microbiological procedures. This is a study based on bacteriological laboratory records review in which we have extracted a total of 134 urine culture reports using data extraction sheet. We considered all records documented during the stated time period.

Results: A total of 134 isolated organisms were considered pathogens from urine samples, 103 (77%) of which were multidrug resistant with a display of resistance to a minimum of four drugs most notably amoxiclav and cefepime. Gram negative representing the majority of isolated bacteria. *E. coli* was the most frequently isolated bacteria with 53; 44 (83%) of which were MDR, showing high level of resistance to amoxiclav (90%), cefepime (85%), piperacillin (86%) and co-trimoxazole (84%), a level of carbapenem resistance was also observed to aztreonam, imipenem and meropenem showing (69%), (12%) and (18%) respectively. The lowest resistance rate was observed with colistin (2%). *K. pneumoniae* appeared highly resistant to piperacillin (93%), amoxiclav (95%) and cefepime (83%), along with third generation cephalosporins ceftazidime and ceftriaxone (75%) and (65%) respectively. Carbapenem resistance was also present for meropenem (40%), imipenem (52%) and aztreonam (69%). With (10%) resistance rate to colistin; *P. aeruginosa* appeared multidrug resistant in 20 out of 22 isolates, the highest being against cefepime (100%), amoxiclav (88%), ceftriaxone (78%), piperacillin (73%) and ciprofloxacin (72%). Carbapenem resistance was observed to meropenem (53%), (46%) for imipenem and aztreonam (31%).

Conclusion: Out of the several isolated organism from UTI, 85% were gram negative and amongst them *E. coli* was the most common followed by *K. pneumoniae* and *P. aeruginosa*. A large number of those bacteria displayed MDR due to increasing use of antibiotics randomly and irrationally. The involvement of such amount of multidrug resistant bacteria in urinary tract infections is a very serious problem and should not be neglected. Serious steps should be taken by the authorities to improve or at least avoid the worsening of the situation with the hope that it's not too late.

Keywords: *Multidrug Resistance; E coli; K. pneumoniae; S. aureus; Antimicrobial Therapy; Urinary Tract Infections; Uropathogenic Bacteria*

Abbreviations

MDR: Multidrug Resistance; AMR: Antimicrobial Resistance; UTI: Urinary Tract Infection

Introduction

Urinary tract infection (UTI) is the presence of multiplying bacteria within the urinary tract with a threshold number of pathogenic bacteria (10^5 CFU/mL) in urine. Despite the presence of different host defense mechanisms against microbial infection in urinary tract, UTI is present as one of the commonest bacterial infections with symptoms including hematuria, dysuria, cloudy urine and nocturnal enuresis, along with nausea, vomiting and fever [1-3].

Urinary tract infections (UTIs) are the second most common infections in developed countries, representing an important factor of morbidity and mortality, both among hospitalized patients and outpatients [4,5]. Moreover, UTIs are a huge economic burden for institutions of healthcare and national economies for their substantial economic impact attributable by their therapy, hospital costs and working days lost due to recovery [6]. The most common causes of UTIs in both community and nosocomial settings are members of the *Enterobacteriaceae*, the most prevalent is *E. coli* (considered the principal etiological agent), nevertheless, the pathogenic role of non-fermenting Gram-negative bacteria (*P. aeruginosa* and *Acinetobacter spp*) in UTIs are being reported especially in patients with predisposing factors for development of complicated UTIs [7,8].

Very little is known about drug resistance in developing countries such as Sudan. Therefore, our study was conducted to evaluate the current spectrum of activity of antibiotics in UTIs against drugs in common use for treating infections. Shortage of antibiotic discs affects the presentation of the whole antimicrobial sensitivity picture of all isolates for each available disc. However, this study is one of the few that provides updated data concerning wound infection and this could be useful for further studies. Multidrug resistance in bacteria refers to a bacterium resistance to three or more different classes antibiotics. It is important to be aware of the of drug resistance trends to avoid or minimize the threats of treatment failure or the complications associated with chronic infection.

Methodology

Study design and period: A retrospective record review of culture results of all types of wound swabs referred to this private major hospital from 1 June 2020 to 31 December 2020 was conducted. The hospital is considered one of the few hospitals in Khartoum that conduct microbiological procedures.

Data collection: This is a study based on bacteriological laboratory records review in which we have extracted a total of 134 urine culture reports using data extraction sheet. We considered all records documented during the stated time period.

Ethical consideration: Approval was obtained from the lab director and administrator after submitting and presenting the research proposal.

Data processing and analysis: Data regarding antimicrobial susceptibilities, and resistance determinants were entered into a computer program. Data were analyzed using Excel and interpreted according to percentage.

Results

A total of 134 isolated organisms were considered pathogens from urine samples, 103 (77%) of which were multidrug resistant (four drugs or more).

Gram negative representing the majority of isolated bacteria (Figure 1). *E. coli* was the most frequently isolated bacteria with 53; 44 (83%) of which were MDR, showing high level of resistance to amoxiclav (90%), cefepime (85%), piperacillin (86%) and co-trimoxazole (84%), a level of carbapenem resistance was also observed to aztreonam, imipenem and meropenem showing (69%), (12%) and (18%) respectively. The lowest resistance rate was observed with colistin (2%).

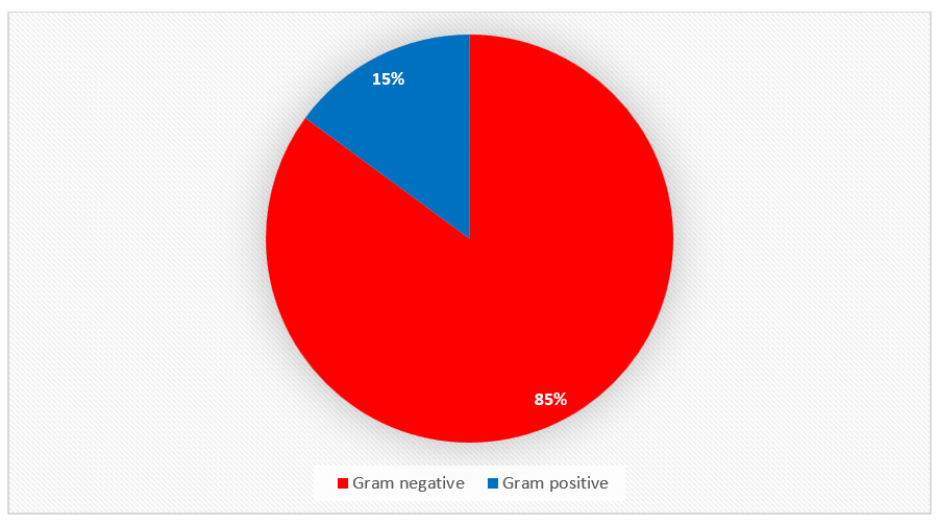

Figure 1

K. pneumoniae appeared highly resistant to piperacillin (93%), amoxiclav (95%) and cefepime (83%), along with third generation cephalosporins ceftazidime and ceftriaxone (75%) and (65%) respectively. Carbapenem resistance was also present for meropenem (40%), imipenem (52%) and aztreonam (69%), with colistin being the most effective antibiotic.

With (10%) resistance rate to colistin; *P. aeruginosa* appeared multidrug resistant in 20 out of 22 isolates, the highest being against cefepime (100%), amoxiclav (88%), ceftriaxone (78%), piperacillin (73%) and ciprofloxacin (72%). Carbapenem resistance was observed to meropenem (53%), (46%) for imipenem and aztreonam (31%) (Table 1).

Antibiotics	***K. pneumoniae*** **(n = 28)**	***A. baumannii*** **(n = 3)**	***P. aeruginosa*** **(n = 22)**	***E. coli*** **(n = 53)**	***Proteus* spp** **(n = 4)**	***Citrobacter* spp** **(n = 1)**	***K. oxytoca*** **(n = 3)**
Colistin	4%	0%	10%	2%	100%	0%	0%
Meropenem	40%	33%	53%	18%	25	100%	0%
Imipenem	52%	50%	46%	12%	50	100%	0%
Aztreonam	69%	100%	31%	69%	0%	-	100%
Amikacin	13%	50%	55%	45%	50%	0%	0%
Gentamicin	30%	67%	53%	45%	50%	0%	0%
Ciprofloxacin	58%	100%	72%	69%	0%	100%	67%
Ceftazidime	75%	100%	68%	69%	0%	100%	50%
Ceftriaxone	65%	100%	78%	70%	33%	-	100%
Amoxiclav	95%	100%	88%	90%	50%	100%	100%
Co-trimoxazole	57%	-	50%	84%	50%	-	0%
Piperacillin	93%	100%	73%	86%	25%	100%	100%
Cefepime	83%	100%	100%	85%	-	-	-

Table 1: *Antibiogram for gram negative bacteria.*

All isolated *A. baumannii* were detected to be MDR, along with *Proteus* spp and *Citrobacter, K. oxytoca* had 2 out of the 3 isolates being MDR. *Proteus* spp was the only microorganism to be fully resistant to colistin (100%), this can be associated with the natural resistance of the genus to this family of antimicrobials. This reflects on the unaware-ness of the staff to nature of the examined microorganisms.

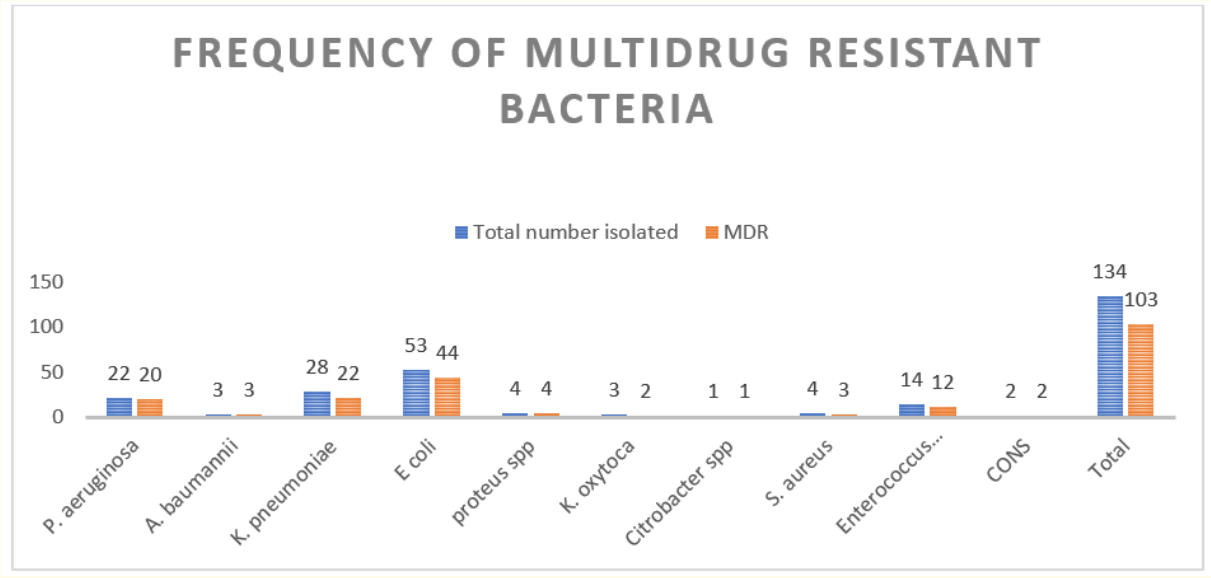

Figure 2

The 20 isolates of gram positive represented (15%) of the entire population of samples, out of 14 *Enterococcus spp* 12 were MDR, with the highest rates of resistance to meropenem (100%), co-trimoxazole (100%), penicillin (92%), tetracycline (89%) and ciprofloxacin (77%). Vancomycin was the treatment option in most cases of gram positive having for least resistance rate (Table 2).

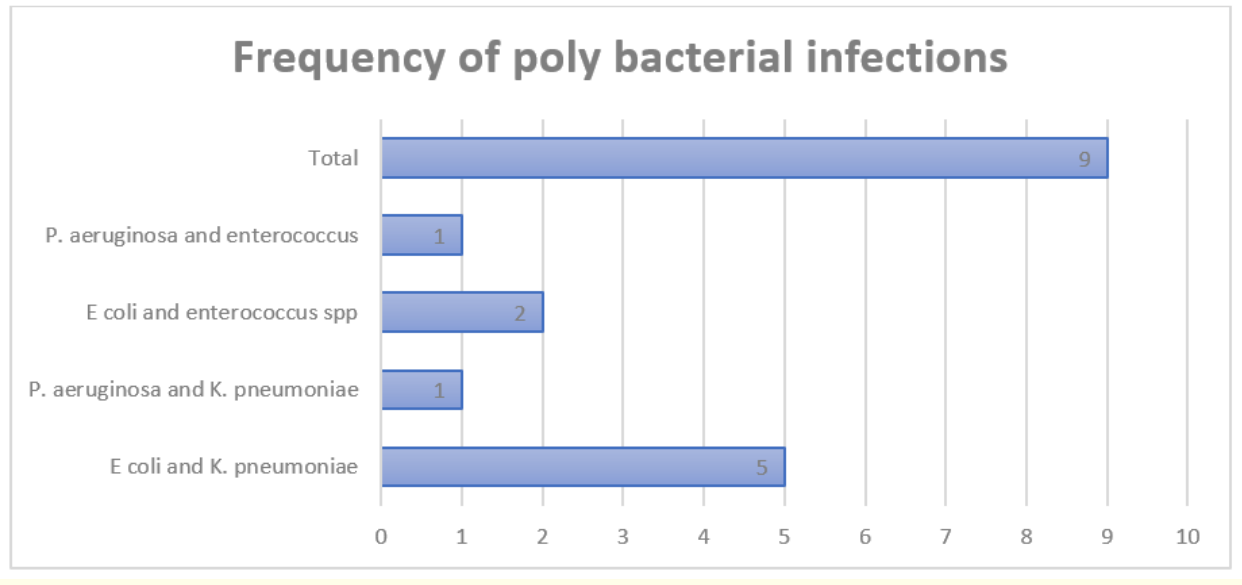

Figure 3

Antibiotic	*S. aureus* (n = 4)	*Enterococcus* spp (n = 14)	CONS (n = 2)
Vancomycin	0%	15%	0%
Meropenem	50%	100%	-
Imipenem	50%	37%	-
Penicillin	100%	92%	100%
Ampicillin	67%	67%	100%
Amoxiclav	67%	45%	50%
Ciprofloxacin	67%	77%	100%
Gentamicin	67%	50%	0%
Erythromycin	50%	100%	50%
Amikacin	33%	-	0%
Co-trimoxazole	0%	100%	50%
Tetracycline	50%	89%	0%

Table 2: *Antibiogram for gram positive bacteria.*

Discussion

Among 134 isolates, *E. coli* 53 (40%) were found to be the predominant organism followed by *K. pneumoniae* 28 (21%) and *Pseudomonas aeruginosa* 22 (16%). This is in line with similar study done by Khanal., *et al*. [9,10]. The high prevalence of *E. coli* in causing UTI also resembled studies [11,12]. Out of 134 isolates, 103 (77%) were found to be multidrug resistant. The findings of the present study is much higher at 77% than the results in previous studies conducted in Nepal [9,13,14] noting the MDR causing UTI to be (42.86%), (56.09%) and (48%) respectively. In our study (83%) of the *E. coli*, (78%) of the *K. pneumonia*, (91%) of the *P. aeruginosa* and (75%) of the *S. aureus* were found to be MDR. Those finding are far higher than those reported in previous publications [9,15].

A study in 2016 shows *E. coli* was completely sensitive to amikacin, imipenem, and meropenem, this is different from our results and indicates that *E. coli* has developed resistance to these drugs.

We observed the activity of piperacillin was 86%, ciprofloxacin 69%, amoxiclav 90%, ceftazidime 69% and cotrimoxazole 84% in *E. coli* strains. Which is relatively similar to previous results reported for piperacillin, ciprofloxacin amoxiclav, ceftazidime and cotrimoxazole were 92.1%, 74.75%, 87.6%, 59.6%, and 10.1% [16] and contradicting others [17].

Increasing use of antibiotics and sales/consumption of drugs irrationally are a main reason for the development of multi drug resistant bacteria. And due to that, therapeutic options have become limited. The involvement of such large number of multidrug resistant bacteria in urinary tract infections is a very serious problem and should not be neglected. Serious steps should be taken by the authorities in only allowing drugs that have been prescribed by a physician to be sold to improve or at least avoid the worsening of the situation with the hope that it's not too late.

Conclusion

E. coli was the most frequently isolated bacteria with 53; 44 (83%) of which were MDR, *K. pneumoniae* appeared highly resistant to carbapenems including meropenem (40%), imipenem (52%) and aztreonam (69%), with colistin being the most effective antibiotic; *P. aeruginosa* appeared multidrug resistant in 20 out of 22 isolates, the highest being against cefepime (100%) which is far superior to the study [16] (with 33%) but show similarities in the remaining antimicrobials, amoxiclav (88%), ceftriaxone (78%), piperacillin (73%) and ciprofloxacin (72%). Carbapenem resistance was observed to meropenem (53%), (46%) for imipenem and aztreonam (31%), All isolated *A. baumannii* were detected to be MDR, *Proteus spp* was the only microorganism to be fully resistant to colistin (100%).

Conflict of Interest

All authors declared there is no conflict of interest.

Bibliography

1. Leigh DA., *et al*. "Topley and Wilson's principles of bacteriology, urology and immunology". Bacterial diseases, 8th edition, frome and London; Butter and Tanner Ltd 3 (1990): 197-214.

2. Shaikh N., *et al*. "Does this child have a urinary tract infection?" *The Journal of the American Medical Association* 298 (2007): 2895-2904.

3. Hersh AL., *et al*. "Antibiotic prescribing in ambulatory paediatrics in the United States". *Pediatrics* 128 (2011): 1053-1061.

4. Hooton TM., *et al*. "Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 international clinical practice guidelines from the infectious diseases society of America". *Clinical Infectious Diseases* 50 (2010): 625-663.

5. Wiedemann B., *et al*. "Uncomplicated urinary tract infections and antibiotic resistance-epidemiological and mechanistic aspects". *Antibiotics* 3 (2014): 341-352.

6. Simmering JE., *et al*. "The Increase in hospitalizations for urinary tract infections and the associated costs in the United States, 1998–2011". *Open Forum Infectious Diseases* 4 (2017): ofw281.

7. Calzi A., *et al*. "Resistance to oral antibiotics in 4569 Gram-negative rods isolated from urinary tract infection in children". *European Journal of Pediatrics* 175 (2016): 1219-1225.

8. Stefaniuk E., *et al*. "Etiology and antibiotic susceptibility of bacterial pathogens responsible for community-acquired urinary tract infections in Poland". *European Journal of Clinical Microbiology and Infectious Diseases* 35 (2016): 1363-1369.

9. Tek Raj Awasthi., *et al*. "Prevalence of Multidrug Resistant Bacteria in Causing Community Acquired Urinary Tract Infection Among the Patients Attending Outpatient Department of Seti Zonal Hospital, Dhangadi, Nepal". *Nepal Journal of Biotechnology* 3.1 (2015): 55-59.

10. Khanal S. "A study on Microbiology of urinary infection at Tribhuvan University Teaching Hospital, Kathmandu, Nepal". MSc thesis. Tribhuvan University, Central Department of Microbiology (2006).

11. Raza S., *et al*. "Microbiological Analysis of the Urine Isolates in Kathmandu Medical College Teaching Hospital, Kathmandu, Nepal". *Kathmandu University Medical Journal* 36.4 (2011): 295-297.

12. Patel S., *et al*. "Urinary Tract Infections (UTI) Among Patients at G.G. Hospital and Medical College, Jamnagar". *National J Community Medicine* 3.1 (2012): 138-141.

13. Khanal S. "A study on Microbiology of urinary infection at Tribhuvan University Teaching Hospital, Kathmandu, Nepal". MSc thesis. Tribhuvan university, central department of Microbiology (2006).

14. Upadhyay G., *et al*. "Comparative evaluation of urine isolates among kidney transplanted and other UTI suspected patients visiting National Public Health Laboratory, (NPHL) Teku, Nepal". *International Journal of Biomedical and Advance Research* 4.6 (2013): 369-375.

15. Tuladhar NR., *et al*. "Antimicrobial resistant bacterial strains from inpatients of Tribhuvan University teaching hospital Kathmandu". *Journal of Institute of Medicine Nepal* 25 (2003): 19-26.

16. Mohammed MA., *et al*. "Prevalence and antimicrobial resistance pattern of bacterial strains isolated from patients with urinary tract infection in Messalata Central Hospital, Libya". *Asian Pacific Journal of Tropical Medicine* 9 (2016): 771-776.

17. Muhammad Imran Khan., *et al*. "Assessment of multidrug resistance in bacterial isolates from urinary tract-infected patients". *Journal of Radiation Research and Applied Sciences* 13.1 (2020): 267-275.

Volume 11 Issue 1 January 2023