GSC Biological and Pharmaceutical Sciences

eISSN: 2581-3250 CODEN (USA): GBPSC2

Cross Ref DOI: 10.30574/gscbps

Journal homepage: https://gsconlinepress.com/journals/gscbps/

(RESEARCH ARTICLE)

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Klebsiella pneumoniae, an important Uropathogen: Characteristics and antimicrobial susceptibility pattern at Prof. Dr. I.G.N.G. Ngoerah general hospital, period February – September 2020

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GSC Biological and Pharmaceutical Sciences, 2023, 24(01), 380–384

Publication history: Received on 16 June 2023; revised on 26 July 2023; accepted on 29 July 2023

Article DOI: https://doi.org/10.30574/gscbps.2023.24.1.0298

Abstract

Background: *Klebsiella pneumoniae* (*K. pneumoniae*) caused urinary tract infections (UTIs) are the rise all over the world and have emerged as a significant issue for public health. *K. pneumoniae*'s characteristics as a uropathogen and their antimicrobial susceptibility pattern will be examined in this study at a tertiary care hospital.

Method: The Clinical Microbiology laboratory at Prof. Dr. I. G. N. G. Ngoerah General Hospital was where this descriptive retrospective cross-sectional study was carried out. All urine cultures were included in this study, and Vitek-2 Compact (BioMerieux®) was used to identify and test for bacterial susceptibility. Data were collected over a period February-September 2020.

Result: The results show 60 isolates *K. pneumoniae* was isolated from urine specimens. This study included outpatients and inpatients of both sex with different age. The male (51.7%) has the highest rate of infection compared to the female (48.3%), with adult patients (76.7%) and child patients (23.3%), whereas Extended-Spectrum β-Lactamase (ESBL) producing *K. pneumoniae* (53.3%) and non-ESBL (46.7%). The antimicrobial susceptibility test showed that *K. pneumoniae* mostly sensitive to meropenem (96.7%) and amikacin (93.3%) and resistance to nitrofurantoin (73.3%) and ciprofloxacin (65%).

Conclusion: This study found that the percentage of ESBL producing *K. pneumoniae* was 53.3%. Antibiotics that are often used for the treatment of UTIs, ciprofloxacin and trimethoprim/sulfamethoxazole, have high resistance rate of 65% and 51.7%, respectively. In addition, Ertapenem, meropenem, and amikacin had the highest antimicrobial sensitivity rates.

Keyword: Uropathogen; *Klebsiella pneumoniae*; Susceptibility pattern; Antibiotic resistance

1. Introduction

Clinicians in developing nations frequently encounter urinary tract infections (UTIs), one of the most prevalent infectious diseases. It is estimated that at least 250 million people worldwide experience them annually. Although a wide variety of microorganisms can cause UTIs, *Escherichia coli* and other Enterobacteriacae are the most prevalent pathogens in the community, accounting for approximately 75% of all isolates. Urinary tract infections (UTIs) are one of the most frequent infectious diseases around the world. Urinary tract infections comprise ranges of disorders including pyelonephritis (infection of the kidney) and cystitis (infection of the bladder), which are defined by the

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presence of microorganisms in urinary tract [1]. The relative prevalence of the pathogens is affected in different ways by age, sex, catheterization, and hospitalization.

About half of all women will experience UTIs at some point in their lives. A urinary tract infection (UTI) can be brought on by a number of different bacteria, such as *Escherichia coli* (*E. coli*)*, K. pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, Serratia* and *Enterococci* genus [2]. *K. pneumoniae* is the most common uropathogen after *E. coli*. A study in Italy in 2012 stated that 13,820 uropathogens were isolated and their prevalence was analyzed according to the sex and age group of the patient. Overall *E. coli* produced 67.6% of all isolates, followed by *K. pneumoniae* (8.8%), *Enterococcus faecalis* (6.3%), *Proteus mirabilis* (5.2%), and *Pseudomonas aeruginosa* (2, 5%) [3]. *K. pneumoniae* is often an opportunistic pathogen implicated in UTI and catheter-associated bladder tract infections (CAUTI) in hospitalized patients and compromised individuals. *K. pneumoniae* has many virulence factors such as capsule, adhesin, endotoxin and siderophore and is able to produce extended spectrum beta-lactamase (ESBL) enzymes which cause *K. pneumoniae* to have resistance to various types of antibiotics, especially third generation cephalosporins and monobactams [4].

Delay in appropriate antimicrobial therapy, including inappropriate empirical antibiotic treatment of multidrug-resistant (MDR) bacteria, can lead to adverse outcomes and potentially increased mortality, a longer hospital stays, and higher costs in patients with severe forms of UTI [5]. Local susceptibility studies are required to identify the most effective medications because the geographical location has a significant impact on the antibiotic resistance that is prescribed. This will greatly improve empirical prescribing and reduce treatment cost and duration. The rise in bacterial antibiotic resistance is largely attributable to a lack of regulations regarding the over-the-counter availability of antibiotics, which encourages excessive and irrational antibiotic use as well as increased consumption and inappropriate prescribing [6].

Due to physicians' lack of awareness of UTIs, many patients may be diagnosed too late or never at all, despite the high prevalence of the condition. Many cases are referred to the hospital when UTI becomes severe. Knowing the description of the UTI patients at Prof. Dr. I.G.N.G. Ngoerah General Hospital is important because it can help with early diagnosis and the right treatment.

2. Material and methods

The descriptive cross-sectional design of this study was used to collect secondary data from the medical records of UTI patients treated at Prof. Dr. I.G.N.G. Ngoerah General Hospital February - September 2020. The study was conducted at Prof.Dr. I.G.N.G Ngoerah General Hospital in Denpasar. All patients with UTI who visited at Prof. Dr. I.G.N.G Ngoerah General Hospital, between February and September 2020 comprised the study population. The inclusion criteria for this study were patients with UTI who came at Prof.Dr. I.G.N.G Ngoerah General Hospital, February - September 2020. Patients with UTI who did not have complete medical records that included information about all of the variables being studied were excluded.

An assessment and statement of the ethical suitability of this study was provided by the Research Ethics Commission of the Faculty of Medicine, Udayana University, Prof. Dr. I.G.N.G Ngoerah General Hospital Denpasar (1701/UN14.2.2.VII.14/LT/2023).

3. Results

This research is a descriptive study using a cross-sectional design. From the medical record data, it was found that there were 60 patients with UTI who came to Prof. Dr. I.G.N.G. Ngoerah General Hospital in the period February - September 2020. Characteristics of patients with UTI are presented in tabular form.

Table 1 Characteristics of Antibiotic susceptibility to *Klebsiella pneumoniae*

No	Organism	% susceptibility																
		Ampicillin	Ampicillin/Sulbactam	Piperacillin/Tazobactam	Cefazolin	Cefixime	Ceftazidime	Ceftriaxone	Cefepime	Aztreonam	Ertapenem	Meropenem	Amikacin	Gentamicin	Ciprofloxacin	Tigecycline	Nitrofurantoin	Trimrthoprim/sulfamethoxazole
1	*Klebsiella pneumoniae*	0.0	38.3	68.3	46.7	45.0	48.3	48.3	56.7	48.3	96.7	96.7	93.3	63.3	35.0	83.3	26.7	48.3

Based on the table above, the highest level of susceptibility to *K. pneumoniae* bacteria is in the drugs ertapenem, meropenem, and amikacin with a range of values of 93.3 - 96.7. Through the standard Kirby-Bauer disk diffusion method and using commercial disks, antimicrobial sensitivity and resistance were determined based on the Clinical and Laboratory Standards Institute (CLSI) system.

Table 2 Patient based on gender

Gender	N	%
Male	31	51.7
Female	29	48.3
Total	60	100

Based on the gender of a total of 60 patients with UTIs shown in table 1, it shows that the percentage of UTIs in male patients is higher than that of female with respective percentages of 51.7% and 48.3%.

Table 3 Patient based on age

Age	N	%
Child (≤ 18 years old)	14	23.3
Adult (> 18 years old)	46	76.7
Total	60	100

Based on table 3, the group with the highest characteristics of UTI age distribution, namely as many as 23.3% less with underage (child) and mostly answer 76.7% are adult.

Table 4 ESBL percentage

	N	%
ESBL	32	53.3
Non ESBL	28	46.7
Total	60	100

Based on table 4, the group with the highest characteristics of UTI ESBL percentage, namely as many as 53.3 % with ESBL and 46.7% non ESBL.

Table 5 Characteristics based on hospitalized

Hospitalized	N	%
Outpatient	4	6.7
Inpatient	56	93.3
Total	60	100

Based on table 5, the group with the highest of characteristics UTI hospitalized, which is 93.3% dominantly inpatient rather than 6.7% outpatient.

4. Discussion

In order to successfully treat patients who are complaining of UTIs and decide on an appropriate course of treatment, it is critical to identify the characteristics of uropathogens as well as patterns of antimicrobial sensitivity and resistance. The nature, rates, and patterns of antimicrobial sensitivity and resistance to uropathogens have been the subject of numerous studies.

One of the most important findings of our study was that ciprofloxacin 65% and trimethoprim/sulfamethoxazole 51.7% showed high levels of resistance. This is in appropriate with the current global epidemiology, some antibiotics, especially fluoroquinolones and trimethoprim/sulfamethoxazole, can no longer be used for the empiric treatment of some infections, including UTI, because of their high resistance rate [7]. AlKhateeb *et al* (2016) in their study also shows high resistance to ciprofloxacin (90.9%). This is a sad finding for the world because fluoroquinolones may have been used as over-the-counter medications for mild infections prior to the first medications [8].

In addition, Ertapenem, meropenem, and amikacin had the highest antimicrobial sensitivity rates (over 90%) according this study. Appropriate with other study, fosfomycin, amikacin, and meropenem all demonstrated a significant sensitivity rate against *K. pneumoniae* uropathogens, ranging from 81% to 99,7% [3].

In our study the largest percentage of UTI patients was male (51.7%) and this is different from the study of Giancola *et al* where female patients were the most common as much as 66.7%, in line with other studies where women were most often affected by UTIs [9]. This could be because of a few inclining factors explicit toward ladies. UTIs are most commonly seen in sexually active young women. Other susceptible adults include the elderly and patients requiring urethral catheterization [2]. These results are in appropriate with our study where children are less common than adults, 23.3% and 76.7%, respectively.

ESBL-producing *K. pneumoniae* were found 53.3% of the cases in the study, so we looked into their presence. Our findings are very different from the study by Martin *et al*., in that study the proportion of ESBL producing *K. pneumoniae* was 6.6%. In terms of ESBL production, *K. pneumoniae* had greater antimicrobial resistance than *E. coli* [10].

5. Conclusion

This study found that the percentage of ESBL producing *K. pneumoniae* was 53.3%. Antibiotics that are often used for the treatment of UTIs, ciprofloxacin and trimethoprim/sulfamethoxazole, have high resistance rate of 65% and 51.7%, respectively. In addition, Ertapenem, meropenem, and amikacin had the highest antimicrobial sensitivity rates.

Compliance with ethical standards

Acknowledgments

The authors received no specific grants from any funding agency in the public, commercial, or non-for-profit sectors.

Disclosure of conflict of interest

The author reports no conflicts of interest in this work.

References

[1] Momtaz H, Karimian A, Madani M, Safarpoor Dehkordi F, Ranjbar R, Sarshar M, et al. Uropathogenic Escherichia coli in Iran: serogroup distributions, virulence factors and antimicrobial resistance properties. Ann Clin Microbiol Antimicrob. 2013; 12:8. doi: 10.1186/1476-0711-12-8.

[2] Tan CW, Chlebicki MP. Urinary tract infections in adults. Singapore Med J. 2016; 57(9):485–90. doi: 10.11622/smedj.2016153

[3] Magliano E, Grazioli V, Deflorio L, Leuci AI, Mattina R, Romano P, Cocuzza CE. Gender and age-dependent etiology of community-acquired urinary tract infections. Scientific World Journal. 2012; 2012:349597. doi: 10.1100/2012/349597. Epub 2012 Apr 26. PMID: 22629135; PMCID: PMC3351074.

[4] Mayasari, A. P. *Klebsiella pneumoniae* Identification of Producing Extended Spectrum Beta Lactamase (ESBL) and Resistance Pattern of Antibioticss in Ulin General Hospital Banjarmasin. Berkala Kedokteran.2017; https://doi.org/10.20527/jbk.v13i2.4071

[5] Horcajada JP, Shaw E, Padilla B, Pintado V, Calbo E, Benito N, et al. Healthcare-associated, community-acquired and hospital-acquired bacteraemic urinary tract infections in hospitalized patients: a prospective multicentre cohort study in the era of antimicrobial resistance. Clin Microbiol Infect. 2013; 19(10):962–8. doi: 10.1111/1469-0691.12089

[6] Mohamed MA, Abdifetah O, Hussein FA, Karie SA. Antibiotic resistance pattern of Escherichia coli isolates from outpatients with urinary tract infections in Somalia. J Infect Dev Ctries. 2020; 14(3):284–9. doi: 10.3855/jidc.12189

[7] Concia E, Bragantini D, Mazzaferri F. Clinical evaluation of guidelines and therapeutic approaches in multi drug-resistant urinary tract infections. J Chemother. 2017; 29(sup1):19–28. doi: 10.1080/1120009X.2017.1380397

[8] AlKhateeb SS, AlShammari NA, AlZughaibi MA, Ghazwani YG, Alrabeeah KA, Albqami NM. The prevalence of urinary tract infection, or urosepsis following transrectal ultrasound-guided prostate biopsy in a subset of the Saudi population and patterns of susceptibility to flouroquinolones. Saudi Med J. 2016; 37(8):860–3. doi: 10.15537/smj.2016.8.15803.

[9] Giancola SE, Mahoney MV, Hogan MD, Raux BR, McCoy C, Hirsch EB. Assessment of Fosfomycin for Complicated or Multidrug-Resistant Urinary Tract Infections: Patient Characteristics and Outcomes. Chemotherapy. 2017; 62(2):100–4. doi: 10.1159/000449422

[10] Martin D., Fougnot S., Grobost F., Thibaut-Jovelin S., Ballereau F., Gueudet T., D. de Mouy, Robert J. Prevalence of extended-spectrum beta-lactamase producing Escherichia coli in community-onset urinary tract infections in France in 2013. The British Infection Association. Published by Elsevier Ltd. http://dx.doi.org/10.1016/j.jinf.2015.11.009