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Research Article

Antibiotic Susceptibility Profile in Urinary Tract Infection Patients at Tarakan Regional Hospital

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ABSTRACT

Background: Urinary tract infections (UTIs) are common in the community and hospital. In Indonesia, the incidence of UTI reaches 180,000 new cases per year. The most common pathogenic bacteria causing UTIs are dominated by *Escherichia coli*. Early empirical treatment of UTI cases can reduce morbidity. Knowing the pathogenic bacteria involved in urinary tract infections and their antimicrobial susceptibility patterns is necessary to provide appropriate empirical therapy. **Purposes:** Describe bacterial patterns and susceptibility profiles in urinary tract infection patients. **Methods:** A retrospective UTI dataset between 2019-2021whom admitted to Tarakan Regional General Hospital with a diagnosis of UTI. Resistance marker data for ESBL were obtained from the results of identification and resistance using the BD PhoenixTM Automated Microbiology System (Becton Dickinson, USA). The data was analyzed descriptively. **Results:** As many as 40 isolates were analyzed. Consist of *E.coli* (37.5%), *Enterococcus faecium* (20%) and *Klebsiella pneumoniae* (17.5%). The ESBL-producing *E.coli* bacteria rate reached 60%, while ESBL-producing *K. pneumoniae* reached 100%. **Conclusion:** *E. coli* was the most common pathogen, with the highest antibiotic sensitivity being imipenem, meropenem, and amikacin.

Keywords: antibiotic, sensitivity, susceptibility, urinary tract infection

INTRODUCTION

Urinary tract infections (UTIs) are infectious diseases that often occur in the community and hospital. UTIs are classified into upper UTIs (pyelonephritis) and lower UTIs (cystitis, prostatitis), depending on the site of infection. They are divided into complications and non-complications based on the underlying disease of the UTIs and abnormalities in the function or anatomy of the urinary tract (1). Asymptomatic bacteriuria is characterized by the growth of bacteria in the urine in the absence of urinary tract symptoms. Asymptomatic bacteriuria is characterized by $\geq 10^5$ colony-forming units (CFU/ml)) of 2 consecutive midstream urine samples in females or one midstream urine sample in males. Meanwhile, it is considered significant if the catheterized urine sample is $\geq 10^2$ CFU/ml in both men and women (2). Various symptoms that can arise in patients with urinary tract infections include pain during

urination (dysuria), frequent urination (frequency), inability to start the flow of urine, sudden urge to urinate (urgency), and blood in the urine (hematuria). The diagnosis of urinary tract infection is made based on the clinical history of the patient's history and supporting examination in the form of urinalysis and confirmation through urine culture examination, so it is essential to collect urine samples correctly (3–6).

The national incidence of UTI ranges from 90-100 cases/100,000 population per year or approximately 180,000 new cases per year (7). Women have a greater incidence and prevalence than men due to the shorter urethral structure (23.3% vs 6.8%). However, men are categorized as a vulnerable population because UTIs often involve other organs, such as the prostate (8,9). The most common pathogenic bacteria causing UTIs are dominated by *E.coli*, which can account for 75-90% of UTIs, followed by *Klebsiella spp*., *Proteus spp*., and other Gram-negative bacteria. In contrast, the Gram-positive bacteria are *Staphylococcus saprophyticus*, *Staphylococcus aureus*, and coagulase-negative *Staphylococcus* (CoNS) (10). Girma et al. also found *E. coli* as the most common pathogen causing UTI at 42.6%, followed by *Klebsiella sp*. and *Pseudomonas sp* at 10.7% (11).

The impact of antibiotic resistance is increased mortality, morbidity, and health costs. Especially in Southeast Asia, there is a frequent use of antibiotics, reaching more than 80% in various provinces in Indonesia. Early empirical treatment of UTI cases can reduce morbidity. To provide appropriate empirical therapy, it is necessary to know the pathogenic bacteria involved in urinary tract infections and their antimicrobial susceptibility patterns (10,12). Definitive therapy needs to be given, as in *E.coli* infections, which can be given according to the sensitivity pattern. However, resistance patterns are a new challenge in the management of UTIs. A study showed resistance patterns of *E.coli* to ampicillin (86%), amoxicillin (76%), tetracycline (71%), trimethoprim-sulfamethoxazole (64%), cephalexin (61%), and cephalothin (60%) (13). This can reduce the effectiveness of treatment and patient recovery. The importance of the right choice of antibiotics is also influenced by the bacterial etiology of urinary tract infections in patients (14,15). So, in this study, a search will be conducted regarding the bacteria that cause urinary tract infections at Tarakan Hospital in 2019-2021.

METHODS

A retrospective UTI dataset between 2019 - 2021 who was admitted to Tarakan General Hospital. The sample size used is total sampling, which performed urine culture with positive results. Data were taken based on medical records. Data collected included urine culture results and antibiotic susceptibility from patients diagnosed with UTI. A clinician diagnosed UTIs. Culture and susceptibility tests were performed using the BD Phoenix machine Automated Microbiology System (Becton Dickinson, USA), which includes resistance markers for ESBL (Extended Spectrum Beta Lactamase). The data was analyzed descriptively. This study has received approval from the UKRIDA Faculty of Medicine and Health Sciences ethics committee with an ethics review pass number 1297/SLKE-IM/UKKW/FKIK/KE/VIII/2022.

RESULTS

The results obtained from 40 samples found a total of ten types of organisms, they are: *Escherichia coli, Eenterococcus faecium, Klebsiella pneumoniae, Pseudomonas aeruginosa, Enterococcus faecalis, Enterobacter cloacae, Acinetobacter baumannii, Staphylococcus*

haemolyiticus, Salmonella sp., and *Pseudomonas putida* (table 1). The top five bacteria causing UTI were *E. coli* (37.5%), *E. faecium* (20.0%), *K. pneumoniae (*17.5%), *P. aeruginosa* (7.5%), and *E. faecalis* (5%).

Table 1. Distribution of bacteria causing urinary tract infection in Tarakan Regional General Hospital (n=40)

Bacteria	Total n (%)
Escherichia coli	15 (37.5)
Enterococcus faecium	8 (20.0)
Klebsiella pneumoniae	7 (17.5)
Pseudomonas aeruginosa	3 (7.5)
Enterococcus faecalis	2 (5.0)
Enterobacter cloacae	1 (2.5)
Acinetobacter baumannii	1 (2.5)
Staphylococcus haemolyticus	1 (2.5)
Salmonella enterica ssp enterica sv Typhi	1 (2.5)
Pseudomonas putida	1 (2.5)

There are 14 types of antibiotics used as a sensitivity test against the bacteria obtained. The antibiotics used include Amikacin, ampicillin, cefepime, cefotaxime, cefoxitin, ceftazidime, ciprofloxacin, clindamycin, gentamicin, imipenem, levofloxacin, meropenem, trimethoprim-sulfamethoxazole, vancomycin.

From the results obtained, it can be concluded that a high percentage of *multi drug resistant* (MDR) bacteria in Tarakan Regional General Hospital, such as ESBL (*Extended Spectrum Beta Lactamase*) producing *E. coli,* of the 15 isolates identified, 60% were ESBL producing *E. coli.* Higher results were obtained in *K. pneumoniae* bacteria, of the 7 isolates identified, all were ESBL producers, even resistant to carbapenem antibiotics (meropenem and imipenem). Another bacterium that is also an indicator of MDR bacteria is *P. aeruginosa*, obtained 2 of the 3 isolates (67%) obtained, resistant to carbapenem antibiotics (*Carbapenem Resistant Pseudomonas aeruginosa*).

In the study results, it was found that the dominant pathogen causing UTI was Gram negative bacteria by 75%, including E. *coli, K. pneumoniae, P. aeruginosa, E. cloacae, A. baumannii, S. haemolyiticus, Salmonella sp.,* and *P. putida.* The limitation of this study is the small sample size.

DISCUSSION

This study found that the main cause of UTI in Tarakan Regional General Hospital was *E. coli* species. Other studies have found similar findings, with *E. coli* as the most common agent causing UTI. In addition, other bacteria such as *Klebsiella pneumoniae, Staphylococcus saprophyticus, Enterococcus faecalis*, Group *B Streptococcus* (GBS), *Proteus mirabilis, Pseudomonas aeruginosa, Staphylococcus aureus* and *Candida spp* can also be found in non-complicated UTI (16).

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Table 2. Results of Antibiotic Susceptibility Test for Bacteria

Microorganism	Amikacin	Ampicilin	Cefepime	Cefotaxime	Cefoxitin	Ceftazidime	Ciprofloxacin	Clindamycin	Gentamycin	Imipenem	Levofloxacin	Meropenem	Trimethoprim-Sulfomethoxazole	Vancomycin
Escherichia coli	87	0	40	40		40	27		60	93	25	93	27	
Enterococcus faecium	0	0			0		0	0	0				0	100
Klebsiella pneumoniae	0	0	0	0		0	0		0	0	0	0	14	
Pseudomonas aeruginosa	67	0	33	0		33	33		67	33	33	33	0	
Enterococcus faecalis	0	100			0		0	0	0				0	100
Enterobacter cloacae	100	0		100		0	100		100	100	100	100	100	
Acinetobacter baumannii	100	0	0	0		100	100		100	0	100	0	0	
Staphylococcus haemolyticus		0			0	0	0	0	0				100	100
Salmonella enterica ssp enterica sv typhi	0	0	100	100		0			0	100	100	100	100	
Pseudomonas putida	100	0	0	0		0	0		0	0	0	0	0	

%S 0-49
%S 50-75
%S 76-100
Analysis not performed

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Whereas in complicated UTI, *Enterococcus sp. is* often found as the causative agent (16). Another study with similar results was conducted by Rosana et al. in Indonesia, which found that the most common pathogen causing UTI in pregnant women was E. coli, at 26.7%, followed by Klebsiella at 20% (17). The same results were also obtained in a study conducted in Surabaya, Indonesia, where the most common pathogenic bacteria causing UTI was E. coli at 42.33%, followed by K. pneumoniae at 11.63% (18).

In this study, the prevalence of ESBL-producing *E. coli* bacteria was 60%, while in *K. pneumoniae it* reached 100%. This result is similar to a study conducted at Sanglah General Hospital by Kurniawati et al., where the ESBL-producing *E. coli* rate was 63.82%. Still, the prevalence was lower for ESBL-producing *K. pneumoniae,* which was 69.39% (19). These results are also similar to the study conducted by Muhajir et al., where the frequency of ESBL-producing K. *pneumoniae* in UTI patients reached 60.7%. A more negligible prevalence was found in ESBL-producing *E. coli* in UTI patients, which amounted to 37.5% (20). Different results were shown in a study conducted by Bhagarva et al. in India, where the ESBL-producing *E. coli* rate was 40.46%, while ESBL-producing *K. pneumoniae* was not found. Still, the number of MDR (multi-drug resistant) bacteria reached 96% of all pathogens found (21).

This study found that 100% of Gram-negative pathogenic bacteria were resistant to ampicillin, 83% were resistant to ciprofloxacin, and 75% were resistant to trimethoprim-sulfamethoxazole. A similar study also found that *E. coli* was 86% resistant to ampicillin, 64% to trimethoprim-sulfamethoxazole, and 28% to ciprofloxacin. This is also similar to the study of Utami et al., who found Gram-negative bacteria resistant to amoxicillin 100%, ampicillin 96.05%, trimethoprim-sulfamethoxazole 62.5%, and ciprofloxacin 64%. This was also true for *Staphylococcus* and *Klebsiella* species, with ampicillin being the agent with the most significant resistance, followed by trimethoprim-sulfamethoxazole. This study also states imipenem as the antibiotic with the highest sensitivity, and ciprofloxacin still has high sensitivity despite the visible resistance pattern (8,18). Whereas in Gram-positive bacteria dominated by *E. faecium,* all eight isolates obtained were resistant to ampicillin, trimethoprim-sulfamethoxazole, and other antibiotics tested, except Vancomycin was still 100% sensitive. Utami et al. study data also obtained trimethoprim-sulfamethoxazole antibiotics 90% of Gram-positive bacteria have been resistant while vancomycin sensitivity rate reached 90% against Gram-positive bacteria (18).

For *E. coli* bacteria, antibiotics that still have good sensitivity are the carbapenem group, including Imipenem and meropenem, which are 93% sensitive, and amikacin, 87% sensitive. At the same time, for K. pneumoniae, none of the antibiotics have good sensitivity. Still, unfortunately, in this study, no test results were carried out on colistin or polymyxin and ceftazidime-avibactam, which are usually quite effective for multi-drug resistant Enterobacterales bacteria. The results of this study are similar to the study of Bhagarva et al., who found that antibiotics that are still good for Gram-negative bacteria are amikacin, gentamicin, and Imipenem, while for Gram-positive bacteria are vancomycin (21). The same results were also obtained from the study of Hanoon et al, found that the most common bacteria causing UTI was *E. coli* with good antibiotic sensitivity results were imipenem by 92.9% and amikacin by 85.7% (22). The results of the Mekonnen et al. study found that antibiotics that

still have good sensitivity are meropenem, ciprofloxacin, and amoxicillin-clavulanate against Gram-negative bacteria, while for Gram-positive are rifampin and ciprofloxacin (23).

Increasing resistance can be a problem as it reduces the effectiveness of treatment. This is coupled with the relatively slow rate of antibiotic discovery. According to the Infectious Disease Society of America (IDSA), there are several ways to prevent antibiotic resistance, including direct communication with clinicians and feedback to reduce antibiotic overuse, limiting the use of antimicrobials in the formulary through special authorization, creating clinical care plans unique to each health institution based on data on local bacterial patterns and resistance trends, de-escalation and reasonable treatment to eliminate unnecessary therapy, optimizing doses based on pharmacokinetic and pharmacodynamic features of the site of infection, and performing appropriate parenteral to oral conversion (24).

CONCLUSION

The most common bacteria causing UTI at Tarakan Regional General Hospital, Jakarta, is *E. coli*, 37.5% for Gram-negative, and *Enterococcus faecium*, 20% for Gram-positive bacteria. The study showed a high prevalence of ESBL-producing *E. coli* and *K. pneumoniae. The* resistance test results showed that the antibiotics with the highest sensitivity for *E. coli* were imipenem, meropenem, and amikacin. Meanwhile, *E. faecium* is vancomycin, which has the highest sensitivity.

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CONFLICT OF INTEREST

All authors declare no conflicts of interest in this paper.

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