Fes)requency of E. coli in Urinary Tract Infection Patients (Complicated Versus Uncomplicated Cas

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Abstract

Objective: To observe the frequency of E.coli among patients suffering from UTI, whether the frequency of E. coli in UTI patients varies across different age groups and genders, observe potential risk factors, such as underlying comorbid or lifestyle factors, that may contribute to the prevalence of E. coli in UTI cases, compare the frequency of E. coli with other uropathogens associated with UTIs and to observe the frequency of E.coli in complicated and uncomplicated UTI cases. Retrospective cross-sectional study.

Material and Methods: This retrospective cross sectional study at Madinah Teaching Hospital from January 2023 to July 2023, The details of E. coli grown from urine sample patterns were collected from the laboratory registers and the patient details were collected from the case records. The urine samples received were processed using standard methods.

Results: The most frequent organism responsible for UTI was E. coli. 34.5% of cases reported E. coli growth and other organisms were found in 13.1% of the patients, while the rest showed no growth on urine culture. E. coli was observed in 66.2% of complicated cases and 29.2% of uncomplicated cases. The most common comorbid observed in complicated UTIs were urinary tract obstruction (13.8%), Diabetes Mellitus (13.5%), a urine sample taken from the catheterized patient (10.6%), and pyelonephritis (5.3%). Complications that arose due to UTI AKI (6.9%) had E. coli frequency of 96.7%, pyelonephritis (6.2%) had 71.4% and sepsis (8.7%) had 94.8%.

Conclusion: E. coli was responsible for causing UTIs in the majority of the patients. It was the most common culprit associated with complicated and uncomplicated UTI cases.

Keywords: UTI, E. coli, frequency of E. coli, complicated UTI, simple UTI

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Introduction

UTIs are frequent infections that occur when pathogens like bacteria, usually from the skin or rectum, pass into the urethra and transmit the disease to the urinary tract.[1] The pathogens can affect different parts of the urinary tract, but the usual type is a bladder infection (cystitis).[2] Indicators of UTI can consist of dysuria or burning while micturition, polyuria, strangury, hematuria, pressure, or cramping in the lower groin. Warning signs and the occurrence of urinary pus cells ≥ 5 per HPF formulate the verdict of UTI, which is verified by urine culture and sensitivity.[3] CDC states that UTIs are the most prevalent bacteriological ailment that necessitates medical treatment and have led to 8.6 million hospital care visits during 2007. Furthermore, UTIs rank as the most common illness that results in an antibiotic prescription following a doctor's consultation.[4] An uncomplicated UTI is an infection of the bladder and associated structures without structural abnormality and comorbidities.[5] UTIs with complications manifest with increased rates of morbidity, and a higher chance of medication failure, longer antibacterial courses, and multiple workups.[6] Complicated UTIs can occur as a result of obstruc-

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tion of the urinary tract, hydronephrosis, or renal tract calculi, in diabetics or immunocompromised patients, in the elderly, and involve urinary catheters.[7] According to research, UTIs are the most dominant bacterial infections in basic primary care,[8] and are among the most common diseases with increasing resistance to antibiotics.[9] Additionally, UTIs are now the most frequent hospital- acquired infections,[10] making up as much as 35% of hospital-acquired infections and the second highest cause of bacteremia[11] in patients admitted to hospitals. Patients of all ages and genders are affected by UTIs, with women making up the bulk of cases (87.5%) as opposed to men (71.3%). The anatomical differences between the two genders account for the female gender being targeted more than the male gender.[12] Two main factors make women more prone to urinary tract infections (UTIs): first, their urethras are shorter than those of men, and second, the urethral opening and the anus are near together, making it convenient for the pathogen to move in the urinary tract.[13] It is projected that during their adult lives, around 50% of women will recurrently suffer from acute cystitis.[14] Worldwide, Escherichia coli is acknowledged as the most frequent cause of UTIs, accounting for both community- and hospital-acquired infections.[15] UTIs can also be caused by several other bacteria, including Pseudomonas aeuroginosa, Staphylococcus saprophyticus, Klebsiella sp., Enterobacter sp., Citrobacter sp., and Proteus sp.[16] UTIs are now a serious public health concern because of the growth of bacteria that has become resistant to antibacterial drugs. These notoriously resistant organisms can withstand lethal antibiotic doses via a variety of strategies, including the production of enzymes that break down aminoglycosides and beta- lactamases, changing the targets of the drugs, or upregulating the expression of efflux pumps.[17] Treating UTIs that are resistant to antibiotics thus becomes more difficult.[18] Life-threatening complications can develop when a UTI is left untreated due to a drug's insensitivity to a particular bacteria.[19] There is a chance of complications such sepsis, pyelonephritis, acute renal damage, and even death.[20] The fast changing patterns of antibiotic resistance in the 21st century have made it difficult for the pace of medication discovery and development to keep up.[21] No new broad-spectrum antibiotics have been found since the 1960s, when fluoroquinolones were introduced as an improvement over nalidixic acid. The bacteria that cause UTIs are changing more and more, mostly as a result of things like self-medication,[22] drug abuse, availability of over-the-counter medications, and over use of antibiotics, especially in developing nations.[23] More resistant strains of UTI-causing bacteria have emerged as a result of the abuse of antimicrobial drugs.[24] The availability and use of more recent broad-spectrum antibiotics are restricted in many low- income countries due to limited access to healthcare and the high cost of second-line medications. This study aims to observe the frequency of E. coli among patients suffering from UTI, whether the frequency of E. coli in UTI patients varies across different age groups and genders, observe potential risk factors, such as underlying comorbid or lifestyle factors, that may contribute to the prevalence of E. coli in UTI cases, compare the frequency of E. coli with that of other uropathogens associated with UTIs and to observe the frequency of E.coli in complicated and uncomplicated UTI cases.

Material and Methods

This retrospective cross sectional study at Madinah Teaching Hospital from January 2023 to July 2023,The study was authorized by the Health Ethics Commi-ttee at The University of Faisalabad (Ref: TUF/IRB/259/23). Patients who were advised to have urine cultures and sensitivity tests performed in a variability of medical settings, comprising wards of hospitals, intensive care units (ICUs), emergency rooms (ERs), and outpatient departments (OPDs), were included in the study. Patients whose medical records had missing or insufficient information were not included. As part of standard clinical processes, the data were gathered from laboratory databases and patient charts. The sample size included 449 patients. The data collection process was conducted with utmost confidentiality. Complete confidentiality was maintained during the data acquisition process. Personal and participant-identifying information was removed from the study. The gathered information was arranged and shown in tables. In order to guarantee a representative sample, spanning a wide variety of age groups and genders. To gather data from test findings, electronic medical records, and patient histories, a standardized data collection form was developed. At the selected collection sites, midstream urine samples were collected and processed in accordance with established protocols. The samples were incubated for two days on blood agar, MacConkey agar, and cystine lactose electrolyte deficient (CLED) agar plates. Every day, the growth of the bacteria was observed. Initially, Gram-stained smears were used for analysis. Conventional biochemical tests were emplo-yed to detect

bacteria. These included the coagulase test, which was equipped to differentiate between Staphylo-coccus aureus and coagulase-negative Staphylococcus, and the oxidase test, which was used when Pseudomonas spp. was suspected. Additional bacterial identification was made possible by computerized methods such as Vitek 2 (bioMérieux, Durham, NC, USA) and Micro-Scan (West Sacramento, CA, USA). There was a 95% confidence level for determining the sample size, the desired margin of error 0.05, the effect size of 0.53, and the given formula was used $n = Z2 \times p \times (1 - p)/E2$. The mean age and standard deviation of the data is 46 ± 19. Frequency tables and mean calculations were two of the descriptive analyses carried out. IBM SPSS version 20 was used to analyze the data. The research employed a retrospective cross-sectional observational study.

Results

The study comprised 449 patients, 34% males, and 65.9% females, with variable age groups. The majority of the patients were between 46-60 years of age. Out of all the samples, 59.6% tested positive for pus cells on micro-scopy, 47.8% tested positive for culture growth, and 37.6% resulted in complications of UTI. E.coli was found to be the most frequent organism in culture growth, with a percentage of 52.3%. The second most frequent organism observed was P. aeruginosa (8.9%). The rest of the organisms accounted for were either 1% or below 1%. Multiple risk factors that lead to complications in UTI were studied. The most prominent risk factor observed was urinary tract obstruction (13.8%), followed by Diabetes mellitus (13.5%), a urine sample taken from a catheterized patient (10.6%), pyelonephritis (5.3%), post-surgical case of a urological site (0.4%). The frequency of E.coli across variable data in the study was observed. It was the most frequent organism studied in the age group of 46-60 years. It was reported to be found in 66.2% of complicated UTI cases, post-surgical of a urological site cases (50%), urine sample taken from a catheterized patient (87.5%), pyelonephritis (83.3%), AKI (96.7%), sepsis (94.8%), pyelonephritis (71.4%). Out of all the diabetics in the sample size, E.coli was found in 70.6% of them.

Table 1: *Percentage and frequency of different variables of the data.*

Variables		Frequency	Percent %
Age Groups	1 (1-15)	30	6.6%
	2 (16-30)	81	18.0%
	3 (31-45)	79	17.5%
	4 (46-60)	138	30.7%
	5 (61-75)	100	22.2%
	6 (76-90)	18	4.0%
	7 (91-105)	2	0.4%
Gender	Male	153	34.07%
	Female	296	65.92%
Pus on microscopy	Significant pus cells (>5 per HPF)	268	59.6%
	Non-significant pus cells (<5 per HPF)	181	40.3%
Urine Culture	Positive	215	47.8%
	Negative	234	52.1%
Complicated UTI cases		169	37.6%
Uncomplicated UTI cases		280	62.3%

Table 2: *Incidence of Bacteria causing UTI*

Bacteria causing UTI	Frequency	Percent%
Escherichia coli	235	52.3%
Proteus species	3	0.7%
Klebsiella species	0	0%
Pseudomonas aeuroginosa	40	8.9%
Enterobacter species	3	0.7%
Candida species	5	1.1%
Staphylococcus saprophyticus	7	1.5%
Enterococcus species	0	0%
Serratia species	1	0.2%
Citrobacter species	4	0.9%

Table 3: *Incidence of Risk Factors for Complicated UTI*

Risk Factors for Complicated UTI	Frequency	Percent
Urinary tract obstruction (urethral stricture, BPH, Renal stones)	62	13.8%
Diabetes Mellitus	61	13.5%
Urine sample taken from a catheterized patient	48	10.6%
Post-surgical (urological site)	2	0.4%
Pyelonephritis	24	5.3%

Table 4: *Incidence of complications of UTI*

Complications of UTI	Frequency	Percent
Acute Kidney Injury	31	6.9%
Pyelonephritis	28	6.2%
Sepsis	39	8.7%

Complications of UTI included sepsis (8.7% cases), acute kidney inury (6.9% cases reported), and pyelo-nephritis (6.2% cases).

Table 5: *Incidence of E. coli in different variables across the data*

Incidence of E. coli	Frequency	Percent %
1-15 years of age	7	1.6%
16-30 years of age	17	3.8%
31-45 years of age	27	6.0%
46-60 years of age	49	10.9%
61-75 years of age	44	9.7%
76-90 years of age	9	2.0%
91-105 years of age	2	0.4%
Complicated UTI cases	112	66.2%
Uncomplicated UTI cases	82	29.2%
Diabetes Mellitus	89	70.6%
Urinary tract obstruction	37	59.7%
Post-surgical (urological site)	1	50%
Urine sample taken from a catheterized patient	42	87.5%
Pyelonephritis (risk factor)	20	83.3%
AKI	30	96.7%
Sepsis	37	94.8%
Pyelonephritis (complication)	20	71.4%

Discussion

The present study aimed to investigate the frequency of E. coli in UTI patients, with a particular focus on distinguishing between complicated and uncomplicated cases. The findings of this research shed light on the prevalence and distribution of E. coli in the context of UTIs, providing insights into the microbial etiology of these infections.

Consistent with previous studies[25] our results demonstrated a high frequency of E. coli in UTI patients. E. coli remains a predominant uropathogen, emphasizing its clinical significance in the etiology of urinary tract infections. The prevalence observed in this study aligns with the global epidemiological patterns reported in the literature. In the subset analysis comparing complicated and uncomplicated UTI cases, there were notable differences in the frequency of E. coli. Conversely, uncomplicated UTI cases, occurring in otherwise healthy individuals with normal urinary tracts, also demonstrated a substantial frequency of E. coli. E. coli was somewhat more common in UTIs with complications, which are frequently detected in patients with underlying comorbidities such diabetes or catheterization or urinary tract anatomical or physiological abnormalities. This finding reinforces the hypothesis that E. coli possesses enhanced adaptive mechanisms enabling it to thrive in complex urinary environments. While the prevalence was slightly lower compared to complicated cases, the consistent presence of E. coli highlights its role as a primary causative agent in both clinical scenarios. Clinical practice is significantly impacted by the high incidence of E. coli in both complex and uncomplicated UTIs. It highlights the need of prompt and precise pathogen identification in clinical settings and implies the need for focused antimicrobial treatments. However, treatment plans are made more difficult by the introduction of multidrug-resistant (MDR) E. coli bacteria. The results emphasize how important local antibiograms are for efficiently directing empirical treatment. Clinicians will be able to optimize antibiotic use by routine observation of resistance patterns within particular healthcare settings, lowering the probability of treatment failures and the spread of resistant bacteria. The findings in this study are in line with the meta-analysis conducted by Shaik et al. (2023), which revealed that a sizable percentage of UTI cases worldwide are caused by E. coli. The treatment of UTIs caused by E. coli is made more difficult by the growing antibiotic resistance, which was also noted in this review. Similar patterns were noted in a Saudi Arabian study that found E. coli to be the most prevalent pathogen in both simple and complex infections, indicating its versatility across a range of patient demographics. It is essential to acknowledge certain limitations in the study, including the reliance on retrospective data and potential variations in microbiological testing methods. Future research endeavors could benefit from prospective designs and molecular techniques for a more in-depth understanding of E. coli strains.

Conclusion

This investigation into the frequency of E. coli in UTI patients revealed distinctive patterns in complicated and uncomplicated cases. E. coli remains a predominant uropathogen, and understanding its prevalence and resistance profiles is crucial for optimizing treatment approaches. This research adds to the existing body of knowledge on UTI etiology and provides a foundation for future studies addressing the evolving landscape of urinary tract infections.

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Authors Contribution

SA: Conceptualization of Project
WA, ZR: Data Collection
WA: Literature Search
WA: Statistical Analysis
WA, ZR: Drafting, Revision
WA: Writing of Manuscript