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Antibiogram Of Escherichia. Coli Isolated From Urine Samples Of Patients Attending Tertiary Care Hospital

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Abstract:

E. coli is one of the leading causes of urinary tract infections. In clinical practice, it is critical to detect UTI-causing bacteria and analyse their resistance to routinely administered medicines. A total of 318 urine samples were collected from clinically diagnosed individuals. Of the 318 cases investigated, 178 (55.97%) developed urinary tract infections. The current study was conducted to examine the antibiogram pattern of uropathogenic E. coli. Gentamicin, an aminoglycoside antibiotic, was virtually completely resistant (93.54%) against isolated uropathogenic E. coli. The lowest percentage of sensitivity was demonstrated against ampicillin/sulbactum (7.52%), whereas more susceptibility was detected with fosfomycin (89.24%) and piperacillin/tazobactum (89.24), followed by ceftazidime (87.09%). Aztreonam (81.72%), cefepime (75.26%), meropenem (77.41%), and imipenem (74.19%), respectively. In this investigation, fosfomycin and piperacillin/tazobactum were identified as highly active antibiotics against uropathogenic E. coli.

Keyword: - Uropathogen, E. coli, Antibiogram, UTIs.

INTRODUCTION

Theodar Escherich, a German paediatrician, discovered Escherichia coli in 1885. The genus Escherichia has five species, the most common and clinically important of which is Escherichia coli. E. coli is an obligatory parasite that only lives in the human and animal intestines and cannot thrive freely in nature [1]. E. coli is a gram-negative bacillus; most strains are motile by peritrichate flagella [2]. E. coli is a common cause of many bacterial illnesses, including UTIs, bloodstream infections, otitis media, pneumonia, meningitis, traveler's diarrhoea, and enteric infections [3].

Urinary tract infection (UTI) is described as the continual growth of germs within the urinary tract. UTI affects a number of fragile human body organs, including the bladder, ureters, and urethra. This infection is more common in women due to the female urethra's shorter length and proximity to the anus. UTI affects up to 40% of women at some point in their life, with the majority of them experiencing frequent UTI. Alternatively, the prostate gland contains antibacterial compounds and Zn, which have an important role in the killing of microorganisms such as E. coli, hence inhibiting such infections in men [4]. E. coli is the most common cause of urinary tract infections, accounting for more than 80% of cases. After E. coli, the other more prevalent UTI pathogens are Staphylococcus saprophyticus, Enterococcus spp., Klebsiella pneumoniae, Proteus ssp., Pseudomonas aeroginosa, and Enterobacter spp. [5]. There are several elements that contribute to a uropathogen's virulence, allowing it to penetrate the urinary tract and cause illness. Uropathogenic E. coli adheres to the urothelium via pili, type 1 fimbriae, and adhesins, favouring the development of UTI [6].

Detecting UTI-causing bacteria and analysing their resistance patterns to routinely given antibiotics in clinical practice is critical and useful in enhancing the efficacy of empirical treatment [7]. A variety of antimicrobial drugs efficiently limit the growth of E. coli. B-lactams, fluoroquinolones, aminoglycosides, and trimethoprim-sulfamethoxazole are commonly used to treat community and hospital infections caused by E. coli [8]. The resistance rate of uropathogenic E. coli to several antibiotics has been reported as betalactams (57.4%), co-trimoxazole (48.5%), quinolones (74.5%), gentamicin (58.2%), amikacin (33.44%), cefuroxime (56%), and nalidixic acid (77.7%) [9]. This study is aimed to isolate, identify, and assess the antibiotic susceptibility pattern of uropathogenic E. coli.

Materials and Methods:

Study Area:

The Department of Microbiology, Narayan Medical College and Hospital (NMCH), in the city of Sasaram, Rohtas, Bihar, was the site of this investigation.

Specimen Collection:

The trial ran for one year, from June 2023 to May 2024. A total of 318 urine samples were collected from clinically diagnosed individuals. Urine samples were collected from both the inpatient and outpatient departments at NMCH, Sasasam. Clean catch midstream urine samples were collected in sterile containers.

Isolation of Uropathogenic Bacteria:

Urine samples were cultured on MacConkey, Blood, and CLED Agar (Cysteine Lactose Electrolyte Deficient Media).

Identification of Isolated Uropathogenic Bacteria:

Colony morphology was seen on the incubated plates. Gram's staining was done on slides made from the various colonies observed on the plates. All of the microorganisms obtained from urine in this study were identified using standard biochemical methods [10].

Antibiotic Susceptibility Test:

Antimicrobial susceptibility testing was carried out on a CLED Agar plate utilising Kirby Bauer's disc diffusion technique [11]. The antibiotic sensitivity pattern was obtained in accordance with CLSI (Clinical and Laboratory standard) [12]. The antibiotic discs (Himedia) utilised were Aztreonam (30 mg), Coftazidime (30 mg), Ceftriaxone (30 mg), Cefepime (30 mg), Imipenem (10 mcg), Meropenem (10 mcg), Fosfomycin (200 mcg), Levofloxacin (5 mcg), Gentamicin (10 mcg), Ampicillin/suebactum (100/10 mcg), and piperacillin/Tazobactum (10/10 mcg).

Observations:

In this study, the urine samples of 318 patients were examined. Of the 318 cases investigated, 178 (55.97%) had a urinary tract infection (Table -1). The cultural features of E. coli are summarised in Table 2. Bacterial isolates considered to be E. coli based on cultural and microscopical features underwent the relevant biochemical assays (Table -03). The results in Table-03 reveal that all of the isolates tested positive for indole, methyl red, catalase, and lactoce fermentation but negative for oxidase, citrate, and Voges-Proskauer. Among the pathogenic bacteria identified, E. coli was the most frequently isolated uropathogen (52.24%), followed by K. pneumoniae (17.41%), P. aeruginosa (8.98%), P. vulgaris (6.74%), Staphylococcus (5.61%), Acinetobacter (6.17%), and Enterobacter (2.80%) respectively (Table-4).

The current study was conducted to investigate the antibiogram pattern of uropathogenic E. coli (Table 5). The aminoglycoside antibiotic gentamicin was nearly as resistant (93.54%) to the isolated E. coli. The lowest percentage of sensitivity was manifested against Ampicillin and Sulbactum (7.52%), followed by Ceftriaxone (13.97%), Levofloxacin (51.61%), while more susceptibility was observed with fosfomycin (89.24%) and piperacillin/tazobactum (89.24%), followed by ceftazidime (87.09%), azitreonam (81.72%), Cefepime (75.26%), meropenem (77.41%), and imipenem (74. 19%), respectively (Table-5).

Table- 1
Bacterial isolation rate from urine samples
(n=318)

Isolated bacteria	Frequency	Percentage
Notable bacterial growth	178	55.97%
Absent of Growth	140	44.02%
Total	318	100%

Table- 1
Bacterial isolation rate from urine samples
(n=318)

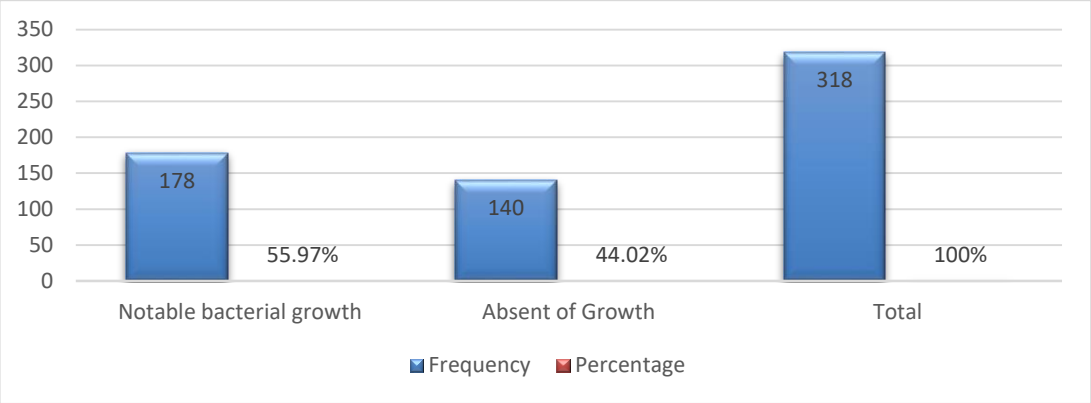


Table -2
Cultural characteristics of E. coli on different media

Media	Cultural characteristics
MacConkey agar medium	The colonies had a pink tint and were round, smooth and flat.
Blood agar medium	Colonies were smooth, wet and greyish-white
CLED agar medium	Colonies were large, raised, translucent with a slightly deepar yellow centre

Table -3
Biochemical characterization of urine-isolated E. coli.

Biochemical tests	Urine isolated E. coli
Citrate Utilisation test	-
Indole production test	+
Methyl-red test	+
Voges-proskauer test	-
Catalase test	+
Oxidase test	-
Lactose-utilisation test	+(AG)
H_2s-test	-
Possible organism	E. coli

(+) = Positive, (-) = Negative
(AG) = Acid and Gas production

Table- 3
Biochemical characterization of urine-isolated E. coli.

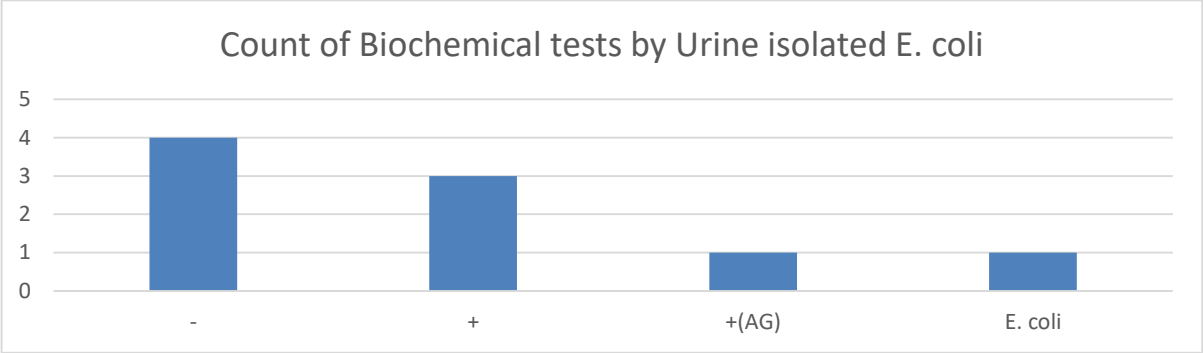


Table- 4
Uropathogens isolated from urine samples
(n = 178)

Uropathogen	Number	Percentage
Escherichia coli	93	52.24%
Klebsiella pneumoniae	31	17.41%
Pseudomonas aeruginosa	16	8.98%
Proteus vulgaris	12	6.74%
Staphylococcus spp.	10	5.61%
Acinetobacter spp.	11	6.17%
Enterobacter spp.	5	2.80%

Table- 4
Uropathogens isolated from urine samples
(n = 178)

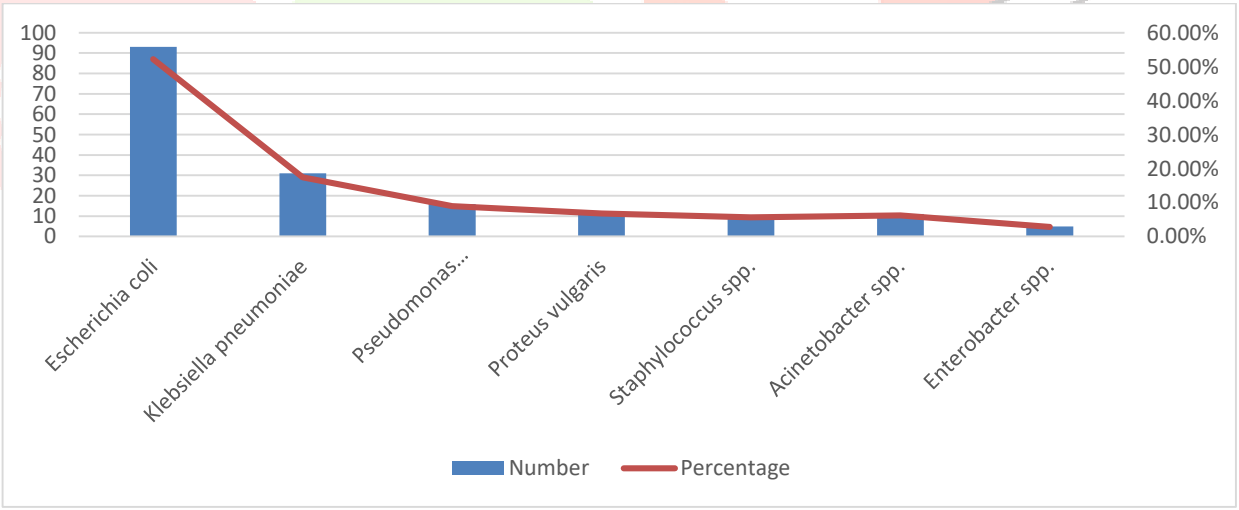
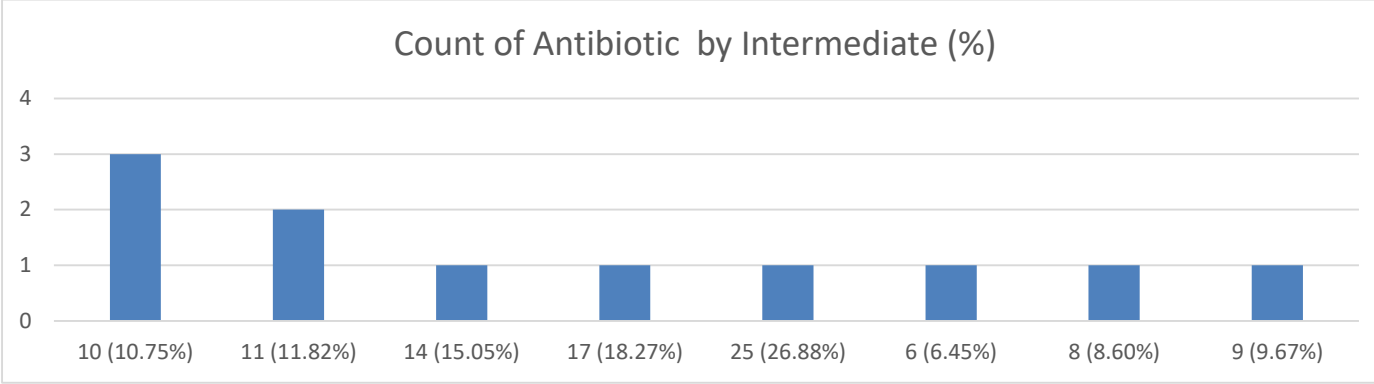


Table- 5
Antibiogram pattern of E. coli by disc diffusion method

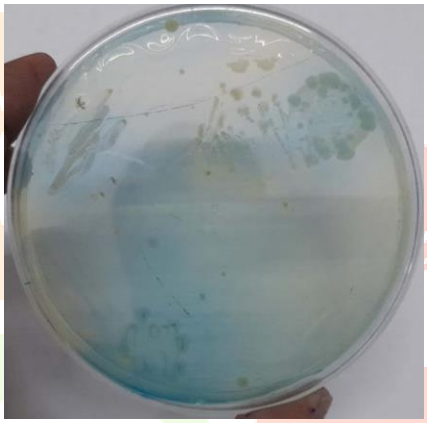
Antibiotic	Sensitive (%)	Intermediate (%)	Resistant
Aztreonam (AT)	76 (81.72%)	17 (18.27%)	-
Ceftazidime (CAZ)	81 (87.09%)	10 (10.75%)	2 (2.15%)
Ceftriaxone (CTR)	13 (13.97%)	9 (9.67%)	71 (76.34%)
Cefepime (CPM)	70 (75.26%)	11 (11.82%)	12 (12.90%)
Imipenem (IPM)	69 (74.19%)	14 (15.05%)	10 (10.75%)
Meropenem (MRP)	72 (77.41%)	8 (8.60%)	13 (13.97%)
Fosfomycin (FO)	83 (89.24%)	10 (10.75%)	-
Levofloxacin (LE)	48 (51.61%)	25 (26.88%)	20 (21.50%)
Gentamicin (GEN)	-	6 (6.45%)	87 (93.54%)

Ampicillin & sulbactam (A/S)	7 (7.52%)	11 (11.82%)	75 (80.64%)
Piperacillin/Tazobactum PIT	83 (89.24%)	10 (10.75%)	-

Table- 5
Antibiogram pattern of E. coli by disc diffusion method



Growth of E. coli on Blood Agar



Growth of E. coli on CLED Agar

Growth of E. coli on MacConkey Agar

Biochemical Characterization of E. coli

Antibiotic Sensitivity Pattern of E. coli

Discussion:

In the current investigation, we assessed the antibiotic susceptibility of E. coli isolates from urinary tract infections. E. coli was the most prevalent isolate. In the current study, they accounted for 52.24% of all isolates, followed by K. pneumoniae (17.41%). Gupta et al. (2014) previously shown E. coli as a significant uropathogen [13]. In this investigation, K. pneumoniae appeared as the second most prevalent uropathogen.

The current finding validates the findings of Manjula et al. (2013). They discovered that the second most prevalent uropathogen is Klebsiella species [14].

Antibiotic resistance posed a significant clinical challenge while treating E. coli infections. The carbepenems (IPM and MRP) employed in this investigation were found to be the most sensitive drugs against uropathogenic E. coli. Meropenem has a sensitivity rate of 77.41 percent against E. coli. Another study conducted in India found that meropenem was extremely sensitive to Gramnegative bacteria [15]. A study conducted in King Fahd Hospital, Saudi Arabia. Meropenem was found to be 95.8% sensitive against extended spectrum beta lactam generating E. coli, followed by imipenem (91.71%) [16].

In In this investigation, Fosfomycin (89.24%) was found to be the most active antibiotic against uropathogenic E. coli using the disc diffusion method. Yashas et al. (2024) reported a similar high rate of sensitivity. They found that 89.47% of E. coli was responsive to Fosfomycin [17]. In this regard, Yashas et al's findings are similar to the current study. Jain et al. (2022) found that 94.48% of uropathogenic E. coli isolates were susceptible to fosfomycin[18]. Cephalosporins are the medicine of choice for treating complex UTIs in hospitalised patients. Unfortunately, the increased usage of third-generation cephalosporins has led to a significant level of resistance [8].

The current study discovered high levels of ceftriaxone resistance (76.34%) in E. coli. This could be due to Extended spectrum Beta - Lactamase (ESBL) in the strains [19]. Mukherjee et al. found a significant proportion of resistance to Ceftriaxone (62.5%) and 45% of the uropathogenic E. coli were ESBL producers in a similar study from North-East India [20]. The rise in ESBL levels may be due to the increased use of third-generation cephalosporins. To preserve their effective antimicrobials, clinicians must rely on routine urine culture and sensitivity testing and treat their patients appropriately. ESBL producers are commonly known to be multidrug resistant (MDR) organisms [8]. In recent years, there has also been an increase in aminoglycoside resistance. Gentamicin is the preferred antimicrobial prophylactic for invasive urological procedures in several countries [21].

In this study, 93.54% of uropathogenic E. coli were resistant to gentamicin. A similar study by Gordon et al. found that the gentamicin resistance rate was 16.25% [22]. In another study, aminoglycoside resistance was 34% [21]. E. coli demonstrated much increased sensitivity to piperacillin/Tazobactum (89.24%). Zubair et al. (2019) found that all uropathogenic E. coli were 100 percent sensitive to piperacillin/Tazobactam [23]. Mohapatra et al. (2022) showed 75.1% susceptibility to piperacillin/tazobactam for urinary E. coli from outpatients in south India [24]. In this study, the susceptibility of E. coli isolates to aztreonam was high, with 81.72% of isolates being sensitive. Malhotra et al. discovered in their investigation that E. coli was 18% sensitive to aztreonam [25].

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