



Original Research Article

Association of Host Characters and Uropathogens in Community and Hospital Acquired UTI

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ABSTRACT

Urinary tract infections (UTI) are the common infections in outpatients as well as in hospitalized patients. *E. coli* is the causative pathogen in 50–80% of cases. Non-*E.coli* infections are more common in complicated UTIs. Studying the host factors that affect urinary etiology and antibiotic susceptibility, helps in formulating appropriate therapeutic strategies. 200 urine samples from adult patients constituting 100 each from community and hospital origin were processed. Data on various host characteristics in the two groups were obtained by review of medical records and questionnaire method. Only those samples yielding single Gram negative uropathogen were selected. Each host characteristic was compared across uropathogen groups using chi square test. Significant P values for association between pregnancy and infection with *Klebsiella pneumoniae* were found in the community acquired (chi-square=4.76; p value < 0.05) and hospital acquired (chi-square=9.36; p value < 0.005) UTI groups. In the hospital acquired UTI group, infection by *Escherichia coli* (chi-square=4.52; p value < 0.05) & *Klebsiella pneumoniae* (chi-square=4.69; p value < 0.05) were significantly associated with urinary catheterization and infection by *Pseudomonas aeruginosa* (chi-square=8.62; p value < 0.005) with diabetes. UTIs due to *Klebsiella pneumoniae* were more likely in pregnancy and due to *Pseudomonas* among the diabetics. Urinary catheterization was more often associated with *E.coli* and *Klebsiella pneumoniae* UTI. An understanding of the host characters and their association with individual uropathogens is essential to tailor the empirical antibiotic therapy.

Keywords

UTI,
Host,
characters,
Community,
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Introduction

Urinary tract infections (UTI) are the common infections diagnosed in outpatients as well as in hospitalized patients.^[1] *E. coli* is the causative pathogen in 50–80% of cases; other *Enterobacteriaceae* together with *Enterococci*, *Streptococci*, *Staphylococci*, and *Pseudomonas spp.*

account for most of the remaining positive urine cultures.^[2] Non-*E.coli* infection is considerably more common (44% to 72%) in the subset of patients with complicated UTIs.^[3] Since underlying host factors may affect urinary etiology and antibiotic susceptibility, specific patient groups should

be investigated in more details.^[4] This may help in formulating an appropriate and focused empirical therapy. Based on this premise we utilized a microbiology oriented approach to identify host characteristics associated with UTIs due to various uropathogen species.

Materials and Method

The study was conducted over a period of one year. Urine samples from adult patients with clinical history suggestive of urinary tract infection, attending the outpatient and inpatient departments formed the source of study.

Urine samples were collected and processed without delay as per standard protocol.^[5] A total of 200 urine samples which included 100 each from community and hospital origin were processed. A review of medical records and a questionnaire was used to obtain the following data Viz: age, gender, h/o recurrent UTIs, h/o antibiotic intake in the preceding three months, diabetes mellitus, h/o urinary tract calculi, pregnancy at the time of infection in patients with suspected community-acquired urinary tract infections (CAUTI). Age, gender, h/o antibiotic intake in the preceding three months, diabetes mellitus, pregnancy at the time of infection, admission in Intensive Care Unit, urinary tract catheterization, history suggestive of urinary tract obstruction, genitourinary instrumentation and immunosuppression were noted in patients suspected with hospital-acquired urinary tract infections (HAUTI).

Only those samples yielding single Gram negative uropathogen were selected. Host factors associated with UTIs were studied separately in Community and Hospital acquired groups. Each host characteristic was compared across uropathogen groups using chi square test.

Results and Discussion

The 200 urine specimens contained isolates representing 8 different Gram negative bacterial species. Chi-square test revealed significant P values (chi-square=4.76; p value < 0.05) for association between pregnancy and infection with *Klebsiella pneumoniae* in the community acquired UTI group. [Table-1]

In the hospital acquired UTI group, patients with urinary catheterization were found to be significantly associated with infection by *Escherichia coli* (chi-square=4.52; p value < 0.05) & *Klebsiella pneumoniae* (chi-square=4.69; p value < 0.05). Patients with pregnancy were found to be significantly associated with infection by *Klebsiella pneumoniae* (chi-square=9.36; p value < 0.005) and patients with diabetes were found to be significantly associated with infection by *Pseudomonas aeruginosa* (chi-square=8.62; p value < 0.005). [Table-2]

Discussion

UTIs are defined as complicated when they occur in patients with immunosuppression, including diabetes, or in the context of structural or functional abnormalities of the urinary tract.^[6] The etiology is affected by underlying host factors that complicate the infection, such as age, diabetes, spinal cord injury, catheterization, genetic factors, menopause, urogenital dysfunction, sexual behavior, and previous pelvic surgery.^[3,7]

As reported in most of the studies^[8,9,10] *Escherichia coli* was the predominant uropathogen in both the study groups and across all host characters.

Analysis of the host characteristics and uropathogens among the CAUTI (Table-1) revealed that h/o recurrent UTIs in the past, h/o antibiotic intake in the previous 3

months, diabetes mellitus and pregnancy (although not statistically significant), were more often associated with infection by *Escherichia coli*.

Patients with pregnancy were found to be significantly associated with infection by *Klebsiella pneumoniae* (chi-square=4.76; p value < 0.05). Our findings also correlate with Shahira *et al.*,^[9] who found *Klebsiella spp.* (45.8%) and *E.coli* (37.5%) as the commonest organisms in pregnant women with UTI attending ANC. It is notable that no *Pseudomonas* and *Proteus spp.* occurred among the pregnant women in our study. *Pseudomonas aeruginosa* is reportedly more often associated with h/o recurrent UTIs, previous antibiotic use & diabetes mellitus suggesting that complicated UTIs and antibiotic usage increases the likelihood of infection by *Pseudomonas aeruginosa*.^[6] Pregnancy associated UTIs are usually community acquired and uncomplicated which is probably why they are more likely to be associated with *E.coli*, *Klebsiella spp.* and not *Pseudomonas aeruginosa*. Contrarily, others have reported *Pseudomonas aeruginosa* 2 (5.3%) apart from *Escherichia coli* 16 (42.1%) and *Klebsiella aerogenes* 7 (18.4%) among pregnant women visiting antenatal clinic.^[11]

As regards HAUTI, majority (46%) of the cases had previous antibiotic use and 21% were catheterized. In each category of host characteristics studied, *E. coli* was the common isolate.

The most important risk factor for the development of nosocomial UTIs, especially in the intensive care setting, is the presence of a urinary catheter.^[12,13] Catheters and other foreign bodies in the urinary tract predispose to UTI by violating natural barriers to infection (urethral sphincter) and providing a nidus for infection by serving as

a substrate for biofilm formation.^[6] Prognosis of catheter-associated UTI may depend on the microorganisms involved and that infection with pathogens, such as *Pseudomonas aeruginosa* or *Escherichia coli*, may carry a higher risk of mortality.^[14] Tabibian JH *et al.*^[6] reported that *Pseudomonas aeruginosa* UTIs were more likely to have undergone urinary tract procedures (43% versus 15% overall), to have a neurogenic bladder (29% versus 12% overall), to have received recent antibiotic therapy (52% versus 24% overall), and to be male (76% versus 28% overall).

However, we found statistically significant association with urinary catheterization and infection by *Escherichia coli* (chi-square=4.52; p value < 0.05) and *Klebsiella pneumoniae* (chi-square=4.69; p value < 0.05) and not *Pseudomonas aeruginosa*. *Escherichia coli* and *Klebsiella pneumoniae* are often found to be the most common causative agents of hospital acquired infections in general; this, apart from the geographical variation of pathogen prevalence, could explain the above findings. Another study too found *Escherichia coli* (29.5%) as the predominant uropathogen in catheterized patients admitted in the ICU which matches with our findings.^[14] These factors suggest that uropathogens vary in different geographical areas and the population studied highlighting the need for local data.

Diabetes and *Pseudomonas aeruginosa* (chi-square=8.62; p value < 0.005) infection were significantly associated in the HAUTI group. Diabetes mellitus is associated with increased risk of certain complicated UTIs such as emphysematous pyelonephritis, emphysematous pyelitis, emphysematous cystitis, xanthogranulomatous pyelonephritis, renal/perirenal abscess, and renal papillary necrosis.^[15]

Table.1 Showing Association of Host Characteristics and Uropathogens among CAUTI Cases. Percentage Values in Parenthesis

Host characteristics	Isolates						Total
	<i>E.coli</i>	<i>K.pneumoniae</i>	<i>C.koseri</i>	<i>P.aeruginosa</i>	<i>P.mirabilis</i>	<i>Enterobacter spp.</i>	
Recurrent UTI	13 (59.09)	4 (18.18)	2 (9.09)	2 (9.09)	1 (1.54)	0 (0)	22
Antibiotic Use	13 (59.09)	4 (18.18)	2 (9.09)	2 (9.09)	1 (1.54)	0 (0)	22
Diabetes Mellitus	13 (72.22)	0 (0)	3 (16.66)	2 (11.11)	0 (0)	0 (0)	18
Pregnancy	11 (68.75)	4 (25)	1 (6.25)	0 (0)	0 (0)	0 (0)	16
Calculi	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	1

Table.2 Showing Association of Host Characteristics and Uropathogens among HAUTI Cases. Percentage Values in Parenthesis

Host Characteristics	Isolates								Total
	<i>E.coli</i>	<i>K.pneumoniae</i>	<i>P.aeruginosa</i>	<i>C.koseri</i>	<i>Enterobacter.spp</i>	<i>P.mirabilis</i>	<i>P.stuartii</i>	<i>Acinetobacter spp</i>	
Antibiotic use	34 (73.91)	6 (13.04)	3 (6.52)	1 (2.17)	1 (2.17)	1 (2.17)	0	0	46
Catheterized	10 (47.61)	6 (28.57)	3 (14.28)	1 (4.76)	1 (4.76)	0	0	0	21
Invasive procedure	14 (70)	3 (15)	2 (10)	1 (5)	0	0	0	0	20
ICU admission	5 (45.45)	2 (18.18)	2 (18.18)	0	1 (9.09)	0	0	1 (9.09)	11
Pregnancy	4 (50)	4 (50)	0	0	0	0	0	0	8
Urinary tract obstruction	6 (66.66)	1 (11.11)	0	0	1 (11.1)	1 (11.1)	0	0	9
Diabetes Mellitus	6 (66.66)	0	3 (33.33)	0	0	0	0	0	9
Immuno-suppression	1 (100)	0	0	0	0	0	0	0	1

Diabetes coupled with UTI caused by pseudomonas is of further concern as the isolate is known to be multidrug resistant in the hospital set up and hence prone for treatment failure by commonly prescribed empirical antibiotics.

Some authors have found an association of *Escherichia coli* in community acquired UTI in diabetics and pseudomonas in hospital acquired UTI^[16], which correlates with our findings. Another study reported a predominance of *Escherichia coli* as compared to *Pseudomonas species*.^[17]

There were 2 isolates of *Proteus mirabilis* associated with calculi/urinary tract obstruction one each in CAUTI and HAUTI. Proteus associated UTI and foreign bodies are reported.^[6]

It is notable that excluding Tabibian JH et al.^[6] to the best of our knowledge we did not find published literature studying multiple host characteristics and uropathogens. At best we found studies focusing on a particular host character like diabetes or urinary catheterization.

Few host factors common to both the study groups were analyzed, overall no significant difference was observed. A higher percentage of patients with antibiotic use among HAUTI group were associated with *Escherichia coli* compared to those associated with *Pseudomonas aeruginosa* among CAUTIs. *Klebsiella pneumoniae* UTIs were significantly associated with pregnancy in both CAUTI and HAUTI cases.

Klebsiella pneumoniae UTIs were more likely to be associated pregnancy associated UTI, and *Pseudomonas* among the diabetic patients. Urinary catheterization was more often associated with *E.coli* and *Klebsiella*

pneumoniae UTI. An understanding of the host characters and their association with individual uropathogens is essential to tailor the empirical antibiotic therapy as per the underlying condition. This will make the therapy more effective and thereby minimize treatment failures and complications. Local data is valuable as geographical variations are known to occur. Furthermore, the findings need to be reviewed periodically.

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