Prevalence and Resistance Pattern of Uropathogens in Pregnant Women- A Cross-Sectional Study

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ABSTRACT

Introduction: Urinary Tract Infection (UTI) is the most common medical problems associated with pregnancy occurring in about 5-10% of pregnant women. It is attributed by various micro-organisms. As the uropathogens is usually Multidrug resistance so, timely identification of these uropathogens and their resistance pattern detection is essential. If UTI is not treated promptly, it can lead to various complications and ultimately can affect health of infant or the pregnant mother.

Aim: To estimate the frequency of UTI and different micro-organisms in pregnant women as well as their antibiotic resistant pattern among them.

Materials and Methods: Present study was conducted in a tertiary care hospital in rural district of Chhattisgarh. During the study period from August 2021 to October 2021, 130 urine samples were collected and processed as per standard protocol. With significant growth on culture ≥10^5 Colony Forming Unit

(CFU)/mL of single morphotype bacteria from a clean catch midstream urine sample UTI diagnosis was established. The bacteria isolated were identified up to species level by standard biochemical tests.

Results: In this study, UTI was found in n=69.2% of pregnant women. The most frequently isolated organism was *E. coli* (53.3%), followed by *Klebsiella spp.* (18.9%) and *Pseudomonas spp.* (3.3%). Highest prevalence rate (85.7%) was observed in the age group 21 to 25 years; most of these (77.8%) were in their 2nd trimester. The isolated pathogens mostly showed multiple drug resistance to two or more antibacterial agents tested.

Conclusion: There was higher incidence of UTI in pregnancy and the most predominant organism isolated was *E. coli*; in 2nd trimester UTI was more common and high level of multidrug resistance was observed. In pregnancy, continuous monitoring of uropathogens including their resistance pattern is required.

INTRODUCTION

The UTI is one of the most common infections encountered in community practice. Nearly, 150 million mortality is reported per year worldwide are due to UTI and its associated complications. Women are more frequently affecting by UTI than the men and in the life time about 40-50% of women are suffering from this [1]. After anaemia, UTIs are the second common complications in pregnant women, which if not controlled well, can adversely affect the health of infant or the pregnant mother [2,3]. Compression of the urethra, enlarged uterus and elevated level of progesterone are important contributing factors for UTI in pregnancy [4]. Various physiological factors favour UTI in pregnant females such as hormonal changes and mechanical pressure effect [5,6]. The risk of urinary stasis and vesicoureteric reflux is increased due to 90% of the pregnant women develop ureteric dilatation which started by 1st trimester and reaches its peak by 22nd-24th weeks of gestation [7]. Urinary stasis also precipitates the problem as during pregnancy glycosuria and aminoaciduria provide an excellent culture medium for bacterial growth [6]. Females with short urethra along with all these factors increase the frequency of UTI in pregnant women. Asymptomatic bacteriuria due to involvement of the lower urinary tract is the most common cause of UTI during pregnancy. But involvement of the upper urinary tract can lead to symptomatic bacteriuria [5,8]. The risk for pyelonephritis, premature delivery and fetal mortality may be increased up to 20% to 40% if UTI is untreated at the proper time. Chance of preterm labour and/or low birth weight is doubled due to asymptomatic bacteriuria. UTI during 3rd trimester may cause mental retardation, developmental delay or fetal death [9].

As the UTI can be caused by various micro-organisms, so to know the exact aetiology, evaluation of bacteriuria among infected persons presents a diagnostic challenge and need a careful assessment. The

bacteria causing UTI are predominantly of the gram-negative group with a small percentage of gram-positive bacteria. *Escherichia coli* accounts for 80% to 90% of infections. Other gram-negative organisms such as *Proteus mirabilis* and *Klebsiella pneumoniae* are also common. Gram-positive organisms such as group B *Streptococcus* and *Staphylococcus saprophyticus* are fewer common causes of UTI [10]. In a study from Southern India, Manjula NG et al., found *E. coli* as the most frequently isolated organism (56.79%), followed by *Klebsiella spp.,* (19.9%), *Pseudomonas spp.,* (6.3%), and *Proteus spp.* (5.8%) [11].

UTI in pregnant women is responsible for several complications and its diagnosis as well as treatment is essential to protect both mother and baby's health. It is caused by various micro-organisms and they pose challenge to treatment as these uropathogens are now showing resistance to multiple antibiotics. So, this study was conducted to know the prevalence of UTI and resistance pattern of the uropathogens among pregnant women in the tribal dominant rural belt of Chhattisgarh.

MATERIALS AND METHODS

This was a cross sectional study from August 2021 to October 2021 of the pregnant females suspected with UTI attending antenatal OPD of the Government medical college, Jagdalpur. This study was conducted with due approval by Institutional Ethical Committee (IEC) (2660/2021). The patients had implied consent for collection and reporting of the results. This study in no way interfered with diagnosis and treatment the patient.

Inclusion criteria: All pregnant females attending various OPDs of the hospital with a clinical suspicion of UTI and having pyuria with albuminuria detected on urine routine examination were included in the study and were further processed.

Exclusion criteria: Non pregnant females and pregnant females with no significant finding on microscopy of urine were excluded from this study.

Sample collection and processing: Freshly voided mid-stream urine samples were collected in sterile wide mouth containers from the individuals and were processed within one hour after the collection. Semi-quantitative urine culture was used to isolate bacterial pathogens on Cysteine Lactose Electrolyte Deficient (CLED) agar plates as per recommendations of Kass criteria [12] with a growth of a single bacterial species at >10^5 CFU/mL from urine sample.

The culture plates were incubated at 37°C for 24 hours to 48 hours. Further, the bacteria grown on culture were identified by type of colony (LF or NLF colonies), Gram stain, motility test and a series of standard biochemical tests such as catalase, coagulase, oxidase, IMViC test (Indole, MR, VP, Citrate utilisation test), Triple Sugar Iron (TSI) test, etc., Sensitivity test was performed to various antibiotics using Kirby Bauer's disc diffusion technique and was interpreted as per Clinical and Laboratory Standards Institute (CLSI) guidelines 2017 [13].

STATISTICAL ANALYSIS

Strict patient confidentiality was maintained during data collection, processing and analysis. The data was analysed by chi-square test using SPSS software 28 version. A p-value less than 0.05 considered statistically significant.

RESULTS

In the study, out of 130 urine samples 90 samples showed significant bacteriuria bacterial growth. So UTI incidence in pregnancy was found to be 69.2%. The age group wise distribution of the samples is shown in [Table/Fig-1].

Age group (in Year)	Total samples tested	No growth (%)	Growth (%)
16-20	18	8 (44.4)	10 (55.6)
21-25	56	8 (14.3)	48 (85.7)
26-30	36	16 (44.4)	20 (55.6)
31-35	10	2 (20)	8 (80)
36-40	8	5 (62.5)	3 (37.5)
≥41	2	1 (50)	1 (50)
Total	130	40 (30.8)	90 (69.2)

[Table/Fig-1]: Age-wise distribution of sample and culture result.

The UTI incidence for different age groups was ranged from 37.5% to 85.7%, women of 21-25 years age group and 31-35 years age group showed highest incidence with 85.7% and 80% respectively [Table/Fig-1].

Trimester	Samples tested	Culture negative (%)	Culture positive (%)
1st	16	6 (37.5)	10 (62.5)
2nd	90	20 (22.2)	70 (77.8)
3rd	24	14 (58.3)	10 (41.7)

[Table/Fig-2]: Culture result related with trimester of pregnancy.

More number of UTI cases was found in 2nd trimester having an incidence of 77.8% than in the 1st and 3rd trimester with that of 62.5% and 41.7%, respectively [Table/Fig-2].

Of the 90 bacterial isolates, most were gram negative bacilli (70, 77.8%) and *Escherichia coli* (48, 53.3%), *Klebsiella spp.* (17, 18.9%) were the major contributors as shown in [Table/Fig-3]. This is statistically significant (p<0.05). *Staphylococcus aureus* (14, 15.6%) was the predominant gram positive uropathogen.

In this study, *E. coli* and *Klebsiella spp.,* were highly sensitive to meropenem (83.3% and 88.2%). Sensitive to meropenem and gentamycin for *P. aeruginosa was* 66.7% each. *S. aureus* strains showed variable sensitive to cefpodoxime (85.7%), nitrofurantoin (57.1%) and amoxycillin-clavulanic acid (57.1%). *Enterococcus species* were more sensitive toward co-trimoxazole and amoxycillin-clavulanic acid (66.7% each).

DISCUSSION

Bacteriuria is common in pregnancy and 20%-30% of asymptomatic bacteriuria will lead to acute pyelonephritis if not treated properly. There may be complications such as low birth weight of infants, premature labour or sometimes stillbirth thus causing serious threat to the mother as well as to the foetus [14]. Proper investigation and timely treatment are needed to prevent serious life-threatening condition and morbidity due to UTI that can occur in pregnant women [15].

As shown in [Table/Fig-4] [11,16-22] in this study, the prevalence of UTI in pregnant women was in higher side (69.2%) and this is similar to that from some studies in India with prevalence rate of 68%, 65% and 64.6% [16-18]. But, it is lower in other studies and varied from 15% to 49.4% [11,19-22]. High prevalence in the present study and variation in different studies may be due to difference in sample size, geographical condition, poor hygiene, low socio-economic status, lack of awareness of healthcare among the rural population.

In this study, the age groups of 21-25 and 31-35 years showed more number of UTI cases with incidence being 85.7% and 80%, respectively, similar to other studies where higher prevalence (>70%) of UTI was reported in 30-34 years and 25-34 years age groups, respectively [23,24]. In another study [25], majority of the infected patients were in the group of 26-30 years (59.38%). This highest prevalence in this age group may be due to high sexual involvement [24].

Highest proportion of UTI cases were found in 2nd trimester with an incidence of 77.8% than those of 1st and 3rd trimester, with incidence of 62.5% and 41.7%, respectively. Urinary stasis, vesicourethral reflux, hormonal changes such as decrease in urinary progesterone and oestrogen in the different trimesters of pregnancy could be the cause for variation [26].

E. coli was found to be the most pre-dominant bacteria among all isolated uropathogens with the incidence rate of 53.3% (n=48). In different other studies [11,17,19,22] also *E. coli* was found to be the predominant pathogen (10.8%-56.8%). In contrast to these, by another study [21] *Klebsiella spp.,* was the predominant one and *E. coli* was the second common pathogen. Due to a number of

Isolated bacteria	Total no. of strains 90 (%)	Number of strains sensitive to antibiotics (%)									
		AMC	AMP	CEF	NIT	COT	MPM	CTR	CPM	GM	CPD
Escherichia coli	48 (53.3)	30 (62.5)	21 (43.8)	28 (58.3)	8 (16.7)	35 (72.92)	40 (83.3)	15 (31.3)	4 (8.33)	20 (41.7)	2 (4.17)
Klebsiella spp.	17 (18.9)	10 (58.8)	2 (11.8)	3 (17.7)	4 (23.5)	2 (11.8)	15 (88.2)	5 (29.4)	1 (5.9)	12 (70.6)	1 (5.9)
Proteus spp.	2 (2.2)	1 (50)	1 (50)	1 (50)	0 (0)	2 (100)	2 (100)	1 (50)	0 (0)	1 (50)	1 (50)
P. aeruginosa	3 (3.3)	1 (33.3)	0 (0)	0 (0)	0 (0)	0 (0)	2 (66.7)	0 (0)	0 (0)	2 (66.7)	0 (0)
S. aureus	14 (15.6)	8 (57.1)	3 (21.4)	4 (28.6)	8 (57.1)	6 (42.9)	0 (0)	1 (7.1)	2 (14.3)	2 (14.3)	12 (85.7)
Enterococcus spp.	6 (6.7)	4 (66.7)	1 (16.7)	2 (33.3)	3 (50)	3 (50)	3 (50)	4 (66.7)	2 (33.3)	2 (33.3)	1 (16.7)

[Table/Fig-3]: Distribution of uropathogens and their antibiotic sensitivity pattern.
AMC: Amoxicillin-Clavulanic acid; AMP: Ampicillin; CEF: Cefoxitin; NIT: Nitrofurantoin; COT: Co-trimoxazole; MPM: Meropenem; CTR: Ceftriaxone; CPM: Cefepime; GM: Gentamycin; CPD: Cefpodoxime

Workers	Place of study	Major pathogen	Frequency of UTI (%)	Sensitivity pattern
Present study	Jagdalpur, Chhattisgarh	*E. coli* (53.3%)	69.2	Meropenem
Mohapatra S et al., 2022 [16]	Multicentric	*E. coli*	68	Ampicillin
Bhonsle K et al., 2022 [17]	Ujjain, Madhya Pradesh	*E. coli* (41.0%)	65	Doripenem, Meropenem and Imipenem
Sadhvi K et al., 2021 [19]	Nagpur, Maharashtra	*E. coli* (10.8%)	24.6	Imipenem
Mamoryi MM et al., 2019 [18]	Babylon Governorate, Iraq	-----	64.6	-----
Rudri Bai IM et al., 2018[20]	Hoskote, Bangalore	-----	15	----
Patnaik M et al., 2017 [21]	Bhubaneswar, Odisha	*Klebsiella spp.* (45%)	25.3	Nitrofurantoin and Cefixime
Manjula NG et al., 2013 [11]	Gulbarga, Belgaum and Bangalore cities of Karnataka	*E. coli* (56.8%)	49.4	---
Jain V et al., 2013 [22]	Lucknow, Uttar Pradesh	*E. coli* (37.6%)	16.9	---

[Table/Fig-4]: Prevalence of UTI in Pregnancy in various studies.

virulence factors specific for colonisation and invasion of the urinary epithelium, such as the P-fimbria and S-fimbria adhesions, *E. coli* was the major culprit [27,28].

Determination of antibiotic susceptibility patterns of uropathogens is essential to initiate prompt treatment of UTI. As the antimicrobial resistance pattern varies from time to time and according to geographical locations, the choice of antimicrobial agents should, therefore, be based on the agent's sensitivity and specificity, side-effects, resistance-pattern, cost and availability. In this study, *E. coli* was highly sensitive to meropenem (83.3%) and sensitivity to co-trimoxazole and amoxycillin-clavulanic acid was 72.9% and 62.5%. It showed resistance to nitrofurantoin, β-lactam antibiotics and aminoglycosides. On the other hand, *Klebsiella spp.* were mostly sensitive to meropenem, gentamycin and amoxycillin-clavulanic Acid (sensitivity 88.2%, 70.6% and 58.8%), respectively. The later showed resistance to most of the antibiotics. In another study, *E. coli* was susceptible to co-trimoxazole (94.87%) but the isolates were also sensitive to gentamycin (94.87%) and nitrofurantoin (84.61%) [25]. The resistance to 3rd generation cephalosporins of gram-negative uropathogens may be caused by Extended Spectrum B-Lactamase (ESBL) production [29,30]. Sensitive to meropenem and gentamycin for *P.aeruginosa* was 66.7% each and it was resistant to most of antibiotics including that to cephalosporins. In contrast in another study, 80% of these were sensitive to cefepime and the lowest sensitivity rate was 20% against ceftazidime [31].

S. aureus strains showed variable sensitive to different antibiotics such as for cefpodoxime 85.7%, for nitrofurantoin 57.1% and for amoxycillin-clavulanic acid 57.1%. They were resistant to most other antibiotics. *Enterococcus spp.,* were more sensitive toward co-trimoxazole and amoxycillin-clavulanic acid (66.7% each). But another study showed all *S. aureus* were sensitive to meropenem [31]. In the present study, most of the isolated pathogens showed multiple drug resistance either of two or more antibacterial agents tested. Irrational use of antibiotics including self-medication for minor infections could be the reason for variation of resistance pattern of bacteria toward different antibiotics.

Limitation(s)

The limitations of the study were the small sample size and short duration of the study. To know the drug resistance mechanisms and different factors contributing UTI in pregnancy, further studies with more cases are needed.

CONCLUSION(S)

Both the mother and baby are at risk if UTI occurs in pregnancy. In this study, there was higher incidence of UTI in pregnancy especially in 2nd trimester and *E. coli* was the most frequently isolated organism; also, high level of multidrug resistance was observed. Continuous monitoring of uropathogens in pregnancy and selection of appropriate antibiotic by doing antimicrobial susceptibility testing is essential to overcome the drug resistance.

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AUTHOR DECLARATION:
• Financial or Other Competing Interests: None
• Was Ethics Committee Approval obtained for this study?   Yes
• Was informed consent obtained from the subjects involved in the study?   Yes
• For any images presented appropriate consent has been obtained from the subjects.   No