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Original Research Article

Bacteriological profile and antibiogram of uropathogens isolated from obstetrics and gynaecology patients in a tertiary care hospital

Gargi Mudey[1]*, Akoijam N. Devi[1], Gaurav Sahu[2], Sheetal Mahajan[1], Supriya Meshram[1]

[1]Department of Microbiology, [2]Department of Medicine, Jawaharlal Nehru Medical College, DMIHER, Sawangi (Meghe), Wardha, Maharashtra, India

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***Correspondence:**
Dr. Gargi Mudey,
E-mail: gargimudey@hotmail.com

ABSTRACT

Background: Urinary tract infection (UTI) is a common complication occurring in obstetric patients, posing adverse risks to both the mother and fetus. The aim of this study is to analyse the bacteriological profile and antimicrobial susceptibility pattern of uropathogens in obstetrics and gynaecology ward for the effective treatment.
Methods: A total of 404 urine samples from pregnant women with different gestational age were processed for the isolation of uropathogens and tested against ten classes of antibiotics. Uropathogens from significant bacteriuria cases were isolated and identified by standard procedures from January 2020 to December 2021. Antibiotic susceptibility was studied by Kirby Bauer disk diffusion method.
Results: Significant bacteriuria in 16.3% samples, *Escherichia coli* (*E. coli*) was the most common uropathogens followed by *Enterococcus sp.* and *Klebsiella pneumoniae* (*K. pneumoniae*). *E. coli* showed highest resistance to ceftazidime, cotrimoxazole and ciprofloxacin while exhibiting high sensitivity to imipenem, meropenem, and amikacin. Moreover, major proportion of isolates of *K. pneumoniae were* resistant against ceftazidime, ciprofloxacin, and nitrofurantoin; and for *Enterococcus species* against penicillin and gentamycin, but 100% sensitive to vancomycin and teicoplanin, and 92.3% to linezolid.
Conclusions: There is a need for screening of antenatal patients for UTI and it is recommended that pregnant women should undergo periodic screening for UTI, so as to monitor the sensitivity pattern of the uropathogens and for the development of specific antibiotic policies based on local susceptibility patterns.

Keywords: Urinary tract infections, Pregnancy, Uropathogens, Antibiotic sensitivity

INTRODUCTION

Urinary tract infections (UTIs) are a significant contributor to the health burden of the community overall ranking second of all prevalent infections, with women experiencing higher incidence rates compared to due to the short urethra which facilitates ascending infection from the perineal flora.[1,2] It is estimated that approximately 50% to 60% of women will endure at least one clinical episode of UTI during their lifetime.[3]

UTIs are frequently encountered in pregnant women.[4] Physiologic changes of the urinary tract like dilatation of the ureter due to progesterone related smooth muscle relaxation and compressions of the lower ureter by the gravid uterus and also vesicourethral reflux which may occur in pregnancy predispose to increase risk of urinary tract infection during pregnancy.[5] Immunologic changes during pregnancy also play a role in increasing the risk of UTI in pregnancy.[6]

Escherichia coli (*E. coli*) is the most common organism causing UTI. Other organisms like *Klebsiella, Proteus, Pseudomonas, Enterococcus,* and *Staphylococcus aureus* also causes urinary tract infection.[7-10] There are various factors responsible for the virulence of an uropathogen

which facilitates them to reach the urinary tract and cause infection. Uropathogenic *E. coli* (UPEC) attaches to the urothelium by pili, type 1 fimbriae and adhesins thereby facilitating the causation of UTI.[11,12]

UTI in pregnancy can lead to grave consequences like premature birth and septicaemia. It should be detected as early as possible and promptly treated. When using antibiotic to treat the infection, the safest to both the mother and foetus should be chosen.

So the present study is conducted to know the bacteriological profile of the uropathogens in our tertiary care hospital and also to know the antibiotic sensitivity pattern of these organisms. This will guide the clinician to choose the proper antibiotic for treating UTIs before the urine culture and sensitivity report is available.

METHODS

This descriptive cross-sectional study was conducted in Acharya Vinoba Bhave Rural Hospital (AVBRH) and department of microbiology- Jawaharlal Nehru Medical College JNMC, Sawangi (Meghe), Wardha, India, during the period from January 2020 to December 2021.The study was included 404 pregnant women attending obstetrics and gynaecology ward with or without clinical symptoms of UTI during the study period. The urine samples received in the lab were analysed. The clean catch mid-stream urine samples in wide mouthed leak proof sterile screw capped containers were taken and examined microscopically. Culture results were interpreted as significant and insignificant. Significant bacteriuria is defined as a urine sample containing more than 105 colonies/ml of urine in pure culture using a standard calibrated bacteriological loop. Cultures with more than three types of colonies were discarded as contaminants.

All samples were inoculated onto CLED agar plates using a calibrated loop (0.01 ml) and were incubated overnight at 37°C and examined next day. Colony counts yielding bacterial growth of 105 CFU/ml were considered significant.

Bacterial pathogens were identified by gram staining, motility and biochemical reactions as per standard microbiological techniques.[13] The antibiotic susceptibility pattern of the isolates was determined by the Kirby Bauer disk diffusion method as per CLSI guidelines.

Gram negative bacilli (GNB) were tested against amikacin (AMK) (30 µg), ceftazidime (CAZ) (30 µg), cotrimoxazole (COT) (1.25/23.75 µg), nitrofurantoin (NIT) (300 µg), ciprofloxacin (CIP) (5 µg), piperacillin tazobactam (TZP) (100/10 µg), and imipenem (IMP) (10 µg).

For gram positive organisms (GPB) ciprofloxacin (CIP) (5 µg), high level gentamycin (GEN) (120 µg), tetracycline (30 µg), linezolid (LZD) (15 µg), vancomycin (VAN) (30 µg), and teicoplanin (TP) (30 µg) were used.

Second line antibiotics were tested only for organisms resistant to all 1st line antimicrobials. These included IMP, cefipime (CEF), ofloxacin (OFX) and piperacillin-tazobactam, for gram negative organisms and VAN, LZD for GPB.

For quality control of the gram positive and gram negative panel of antibiotics the discs were tested with ATCC *Staphylococcus aureus* 25923 and ATCC *E. coli* 25922 respectively. Quality controls are passed when the zone sizes were as per the CLSI criteria.[14] The tabulation and cross tabulation was done. Results were expressed in percentage.

Data entry and analysis was done using statistical package for the social sciences (SPSS) software for windows version 17.0.

RESULTS

A total of 404 samples from pregnant women received during January 2020 to December 2021 were included in this study. The prevalence of UTI among pregnant women is shown in Table 1. Out of the 404 samples, 66 samples showed significant growth.

Table 1: UTI prevalence among pregnant women.

Total no of urine samples screened	No of samples showing significant growth	% of UTI prevalence in pregnant women
404	66	16.3

Majority of the culture positive pregnant patients belonged to the age group of 20-30 years. Age distribution of pregnant women with UTI is given in Table 2.

Table 2: Age distribution of pregnant women with UTI.

Age group	No. of UTI cases	Percentage of total UTI cases
<20	5	7.6
20-29	43	65.2
30-39	15	22.7
≥40	3	4.5

Out of the total 66 culture positives, the total number of GNB isolated were 48/66 (72.7%) and GPB were 18/66 (27.3%) of UTI cases. *E. coli* (n=23; 34.8%) was the most common uropathogen isolated followed by *Enterococcus sp.* (n=13; 19.7%) and *Klebsiella pneumoniae* (*K. pnuemoniae*) (n=11; 16.7%). Table 3 shows uropathogens isolated from pregnant women (Figure 1).

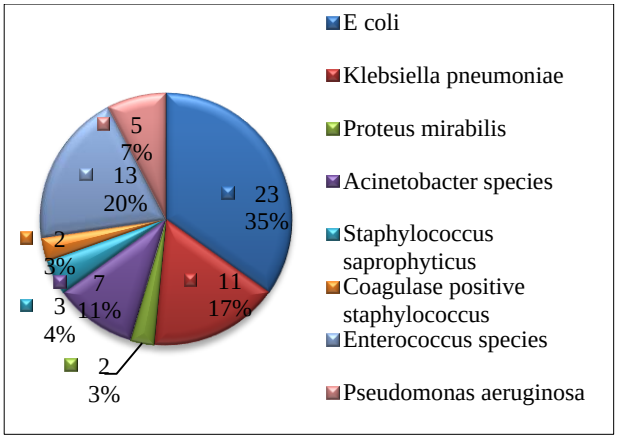

Figure 1: Distribution of bacterial population in pregnant women with UTI.

Gram negative bacteria showed high susceptibility to IMP (84.54%), MRP (81.84%), AMK (80.80%) and GEN (78.74%). Gram negative bacteria are moderately susceptible to the TZP (70.14%). They were poorly susceptible to CEF, COT and CIP in the range of 30% to 35%. Only *E. coli* and *K. pnuemoniae* showed sensitivity towards NIT (69.65 and 54.5% respectively) (Table 3).

The results of the susceptibility testing indicate that GPB exhibited complete susceptibility to VAN, while also demonstrating high susceptibility rates for LZD (88.9%) and TP (94.4%). In contrast, the average susceptibility rate for NIT among GPB was 50%. However, GBP exhibited low susceptibility rates for penicillins, CIP, high level GEN, AMK, and tetracycline. A detailed breakdown of these observations can be found in the table below (Table 4).

Table 3: Antibiotic sensitivity pattern of gram-negative organisms.

Organisms	Antibiotics (%)								
	TPZ	GEN	CIP	NIT	COT	AMK	CAZ	IMP	MRP
***E. coli* (n=23)**	14 (60.9)	16 (69.6)	5 (21.7)	16 (69.6)	9 (39.1)	19 (82.6)	6 (26.1)	20 (87.0)	19 (82.6)
***K. pnuemoniae* (n=11)**	8 (72.7)	8 (72.7)	5 (45.5)	6 (54.5)	7 (63.6)	11 (100)	4 (36.4)	11 (100)	10 (90.9)
***P. aeruginosa* (n=5)**	3 (60)	4 (80)	2 (40)	NT	0	5 (100)	2 (40)	5 (100)	5 (100)
***P. mirabilis* (n=2)**	2 (100)	2 (100)	1 (50)	0	1 (50)	2 (50)	2 (50)	2 (50)	2 (50)
***Acinetobacter sp.* n=7**	4 (57.1)	5 (71.4)	2 (28.6)	NT	0	5 (71.4)	1 (14.3)	6 (85.7)	6 (85.7)

NT: Not tested, piperacillin tazobactam (TZP), gentamycin (GEN), ciprofloxacin (CIP), nitrofurantoin (NIT), cotrimoxazole (COT), amikacin (AMK), ceftazidime (CAZ), imipenem (IMP), meropenem (MRP)

Table 4: Sensitivity profile of gram positive uropathogens.

Antibiotics	Gram positive uropathogens (%)		
	***Enterococcus sp* (n=13)**	***Staphylococcus saprophyticus* (n=3)**	**COPS (n=2)**
Penicillin	2 (15.4)	NT	0
High level gentamycin	2 (15.4)	NT	NT
Tetracycline	4 (30.8)	NT	1 (50)
Amikacin	NT	1 (33.3)	1 (50)
Ciprofloxacin	7 (53.8)	0 (0)	1 (50)
Nitrofurantoin	7 (53.8)	2 (66.6)	2 (100)
Vancomycin	13 (100)	3 (100)	2 (100)
Teicoplanin	13 (100)	2 (66.6)	2 (100)
Linezolid	12 (92.3)	2 (66.6)	2 (100)

NT: Not tested, COPS: coagulase positive *Staphylococcus*

DISCUSSION

The antimicrobial susceptibility pattern keeps changing over years. Hence, it is essential to update our antibiotic policies in order to meet with the current resistant strains. This study gives us valuable data regarding the prevalence of UTI among pregnant patients and also their antibiogram pattern. This data regarding the predominant pathogens in a hospital setting will be very useful for choosing the appropriate antibiotic for empirical treatment of pregnant women with UTI.

In our study the prevalence of UTI among pregnant women is 16.3%. This is almost similar to prevalence of UTI reported by Sadhvi et al (16.2%) and Olsen et al from Tanzania (16.4%).[15,16] Our study also showed that infection rate was high in the age group of 20-30 years (65.2%), followed by 30-40 years (22.7%), <20 years is

7.5%, ≥40 years is 4.5%. The high prevalence of UTI in the age group of 20-30 years was probably due to decreased glycogen deposition, reduced lactobacilli related to aging, bacterial adherence and invasion.[17] Another reason could be increased sexual activity which predisposes them to the introduction of microorganisms to the urinary tract and infection and recent use of diaphragms with spermicide.[18,19]

In our study 72.7% of the organisms isolated were gram negative bacilli and 27.3% were gram positive cocci. This data is similar to the reports which suggest GNB are predominant isolates.[20,21] Similar but higher proportion was reported by Hisano et al and Sibi and colleagues.[22,23] Gram-negative uropathogens may exhibit a high rate of isolation due to specific proteins present on its surface that facilitates attachment to uro-epethelial cells and prevent bacteria from being washed away by urinary flow. This attachment enables the bacteria to multiply and invade the tissues, leading to a higher rate of isolation in UTI.[24] Of the 66 culture positives, *E. coli* was the most common uropathogen (34.8%). This was similar to a study conducted by Nahab et al done among pregnant women in Al Samawa City of Iraq, Rosana et al in a community health centre in Jakarta, Indonesia, and Rao in a tertiary maternity care hospital in Hyderabad.[19,25,26] On the contrary, fewer studies found *K. pneumoniae* as the dominant uropathogen.[27] After *E. coli*, *Enterococcus species* (19.7%), *K. pneumoniae* (16.7%) were the dominant pathogens in this study. The frequencies of the remaining isolates were: *Proteus mirablis* (3%), *Acinetobacter species* (10.6%), *Staphylococcus saprophyticus* (4.6%), coagulase positive staphylococcus (3%), *Pseudomonas aeruginosa* (7.6%). *Enterococcus* has been previously document to cause UTI.[28] All isolates of *E. coli* were sensitive to the antimicrobial panels with varying proportions; most of them were sensitive to IMP (87%), MRP (82.6%), AMK (82.6%), intermediate sensitive to GEN (69.6%), NIT (69.6%), TZP (60.9%). On the other hand, a large proportion was resistant to CAZ, COT and CIP (60-80%). This was similar to the findings of the study done by Bhargava et al and Mohapatra et al.[29,30] However, *K. pnemoniae* had better sensitivity for COT (63.6%) as compared to *E. coli*. The highest sensitivity of *Klebsiella pneumoniae* for antibiotics was 100% for AMK, 100% for IMP, 90.9% for MRP. Additionally resistance to CAZ (63.6%), CIP (54.5%), and NIT (45.5%) was found similar to previous study.[29] The results of the study showed that the second most commonly found uropathogen, *Enterococcus* species, displayed a high sensitivity rate of 100% to VAN and TP, and 92.3% to LZD. However, the species showed a high resistance rate to most other antimicrobials, including penicillin and GEN (84.6% both), and a significant proportion (46.2%) were found to be resistant to NIT. Similar results were found in a study conducted by Hussain and colleagues, was discovered that 90.09% proportion of *E. faecalis* strains displayed resistance to gentamicin.[31] On the contrary Fallah et al found NIT along with LZD, and chloramphenicol were the most effective agents against *Enterococcus* species.[32]

The susceptibility testing for antimicrobial drugs showed that the urinary isolates had a high level of resistance to penicillins, which belong to the beta lactam group of antibiotics. This result is consistent with earlier studies, and may be due to the widespread use of these antibiotics and the increased prevalence of beta lactamase producing strains.[33] As a result, the use of beta lactam antibiotics, which are traditionally considered safe during pregnancy, may be limited. Additionally, most of the GPB isolates had low sensitivity to gentamycin (27.2%), which is known to be nephrotoxic, and therefore should be avoided.[13]

CONCLUSION

The present study showed the prevalence of UTI among pregnant women was 16.3%. The commonest uropathogens was *E. coli*. It was observed that drugs like Ceftazidime, Cotrimoxazole, Ciprofloxacin and Nitrofurantoin which were used for empirical treatment for pregnant women could no longer be that effective in our hospital setting for gram negative uropathogens. Over all most of the gram negative isolates were sensitive to amikacin, gentamycin, meropenem and imipenem. As a first-line antibiotic treatment for gram positive organisms, vancomycin, linezolid, and teicoplanin are recommended. This emphasizes the need for screening of antenatal patients for UTI. Urine for bacterial culture is still the gold standard method for confirming UTI. Hence it is recommended that pregnant women should undergo periodic screening for UTI, so as to monitor the sensitivity pattern of the uropathogens and for the development of specific antibiotic policies based on local susceptibility patterns.

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