Section: Microbiology

Original Research Article

ISOLATION OF COMMON BACTERIAL AGENTS CAUSING URINARY TRACT INFECTION AMONG PREGNANT FEMALES AND THEIR ANTIMICROBIAL SUSCEPTIBILITY PATTERN AT A TERTIARY CARE HOSPITAL IN LUCKNOW

Received : 05/08/2023
Received in revised form : 02/09/2023
Accepted : 13/09/2023

Keywords:
Urinary tract infection, Pregnancy, Escherichia coli, Klebsiella, Antibiotic resistance.

Corresponding Author:
Dr. Syed Abid Asghar,
Email: drsabid@gmail.com

DOI: 10.47009/jamp.2023.5.5.204

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5 (5); 1041-1047

Soophi Shamsi[1], Sarah Hassan[2], Shadama Yaqoob[3], Syed Abid Asghar[4]

[1]Tutor, Department of Microbiology Era's Lucknow Medical college and Hospital, Lucknow, Uttar Pradesh, India.
[2]Assistant Professor, Department of Microbiology Era's Lucknow Medical College & Hospital, Lucknow, Uttar Pradesh, India.
[3]Professor, Department of Microbiology Era's Lucknow Medical College & Hospital, Lucknow, Uttar Pradesh, India.
[4]Assistant Professor, Department of Community Medicine, Eras Lucknow Medical College &Hospital, Lucknow, Uttar Pradesh, India.

Abstract

Aim: To identify the common bacterial agents causing urinary tract infection among pregnant females and their antimicrobial susceptibility pattern. **Background:** During pregnancy, women undergo anatomical, physiological, and hormonal changes that increase their risk of developing urinary tract infections (UTIs). If these UTIs go untreated, they can lead to complications for both the mother and foetus. Additionally, antimicrobial resistance poses a significant challenge in treating UTIs during pregnancy. **Materials and Methods:** A cross-sectional study performed in the Department of Microbiology, Era's Lucknow Medical College & Hospital, Lucknow from October 2022 to March 2023. Clean-catch midstream urine specimens were collected from Patients for culture and identification. AST was done by the Kirby-Bauer Disk Diffusion Method. **Result:** Out of the 114 samples 28 were culture positive for symptomatic UTI. The higher rate of symptomatic UTI was found in second trimester (50%) of pregnancy. Escherichia coli (n=15, 53.6%) was the most common uropathogen isolated followed by Klebsiella species (18%). Gram negative isolates were 100% sensitive to Tigecyclin and Colistin followed by Netilmicin (91.3%), Amikacin (91.3%), and least sensitive to Amoxiclav (39.1%) and Norfloxacin (43.4%). Enterococcus species were 100% sensitive to Vancomycin, Teicoplanin and Linezolid. **Conclusion:** Regular urine culture testing is essential during pregnancy to identify and diagnose urinary tract infections (UTIs) in order to minimize the risks associated with UTIs and drug-resistant bacteria. When selecting antimicrobial treatment for pregnant women, it should be based on the specific sensitivity and resistance patterns of the bacteria, taking into consideration the safety of both the foetus and the mother.

INTRODUCTION

A urinary tract infection (UTI) is an infection that occurs when microorganisms grow in the urinary tract.[1] The urinary tract consists of various parts, and UTIs can be categorized into two types: lower urinary tract infections, which affect the bladder and urethra, and upper urinary tract infections, which involve the kidney, pelvis, and ureter.[2] Most UTIs happen because of an infection that moves upwards in the urinary tract. Typically, this occurs when bacteria from the digestive system enter the urethra and start to multiply, leading to an infection.[3]

UTIs are more frequently seen in women compared to men, with a ratio of 8 women to 1 man, largely due to anatomical and physiological differences between the sexes.[4] In women, UTIs make up around 25% of all infections, making them one of the most commonly occurring bacterial infections in clinical settings.[5] UTIs, which are bacterial infections in the urinary tract, can also be a concern during pregnancy. They can manifest with symptoms like urethritis, cystitis, or pyelonephritis, or they might not show any symptoms at all.[6]

The prevalence of UTIs during pregnancy varies worldwide, with rates ranging from 2% to 10%.[7] In

India, the prevalence of UTIs among pregnant women is reported to be between 3% and 24%.[8]

In women, the likelihood of developing a urinary tract infection (UTI) is higher during pregnancy compared to when not pregnant. This increased susceptibility can be attributed to changes in physiology, anatomy, hormones, and the potential difficulties in maintaining personal hygiene that can arise during pregnancy. These factors collectively make pregnant women more susceptible to urinary tract infections than women who are not pregnant.[9]

Various risk factors contribute to pregnant women's vulnerability to UTIs. These encompass factors such as higher parity (having had multiple pregnancies), frequent sexual activity, advancing age, diabetes, sickle cell disease, and a history of UTIs or recurring UTIs. Additional factors include the stage of pregnancy, level of education, prior instances of catheter use, contraceptive usage, inadequate personal hygiene, and prior use of third-generation cephalosporin antibiotics.[2]

Organisms that cause UTI are mostly from the normal vaginal, perineal, and fecal flora. Most common pathogens responsible for UTI include Escherichia coli, Klebsiella species, Proteus species, Citrobacter, Enterobacter, Enterococcus species, Pseudomonas aeruginosa, Serratia, and Staphylococcus aureus, which colonise in genito-urinary tract. Escherichia coli, Klebsiella species, Pseudomonas aeruginosa, and Proteus species are the most influential gram-negative organisms responsible for UTIs.[10] Among gram-positive bacterial pathogenic strains, Enterococcus faecalis and Staphylococcus aureus, have been found the most common bacteria responsible for UTIs.[1]

The emergence of antibiotic resistance among urinary pathogens has been increasing worldwide and it becomes a serious global public health issue, particularly in the developing countries where a high level of poverty, ignorance, poor hygienic practices, high prevalence of fake and spurious drugs circulation is the contributing factors. Understanding the types of bacteria causing these infections and their response to antibiotics in specific settings is vital for choosing the best treatment approach.[11]

Hence, understanding the causes of UTIs and the patterns of antimicrobial resistance in particular geographical areas can assist medical practitioners in selecting the right empirical antimicrobial treatment. There has been a lack of available information on the occurrence of UTIs in females in Lucknow in recent years. Therefore, this study was conducted to ascertain the prevalence of UTIs and to establish the susceptibility of commonly used antibiotics to microbial agents among females in Lucknow.

MATERIALS AND METHODS

A hospital based cross sectional study was conducted in department of Microbiology of Eras Lucknow Medical college and Hospital, Lucknow. U.P, between October 2022 to March 2023 to Isolate most common Bacterial Agents causing urinary tract infection among pregnant females and their Antimicrobial Susceptibility pattern. Sample size was calculated by formula 4 :

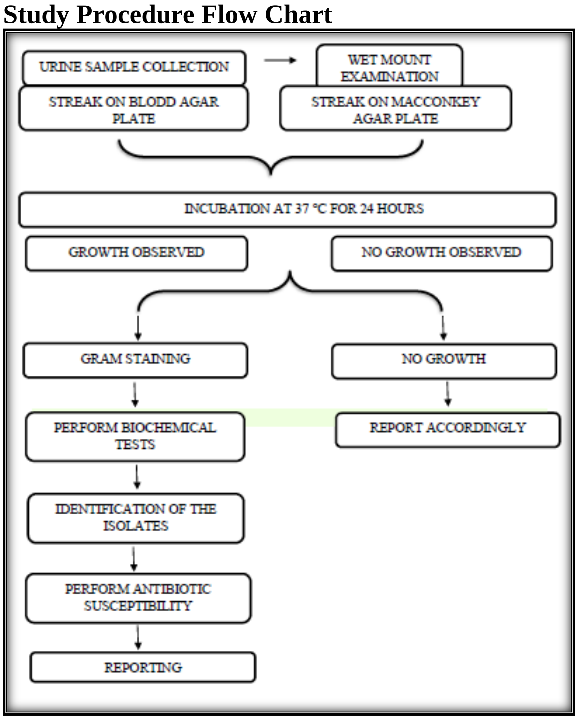
n = {(N*(z2)*P*(1-P) /(e2)} ÷ {(N-1)*(Z)*P(1-P) /(e2)} ,

A total of 141 samples were acquired based on subjective symptom based question where, N (Population size)= 223, Critical value (95% confidence level) (Z) = 1.96, Margin of error (e)=0.05, sample proportion (uncertain)(p)=0.5, Sample Proportion (P)= 0.075.

Data Collection: Urine samples were collected from all pregnant women who attended Antenatal Care at ELMCH's Obstetrics and Gynaecology Outpatient Department (OPD) and Inpatient Department (IPD) and exhibited symptoms indicating a possible urinary tract infection regardless of their stage of pregnancy. All pregnant women who were not currently taking antibiotics and were willing to participate were included in the study.

Sample Collection and Processing: Written informed consent was obtained from each pregnant woman before the commencement of the research and collection of patient information such as age, occupation, parity and duration of gestation were collected from the pregnant women.

Study Procedure Flow Chart



Around 10-20 ml clean-catch midstream urine samples was collected in sterile, properly labelled,

ISSN (O): 2687-5365; ISSN (P): 2753-6556

leak-proof and screw-capped universal container. Sample was transported immediately to the laboratory and processed within 2 hours. All urine samples received in bacteriology lab were subjected to wet mount examination for pus cells, red blood cells, epithelial cells, and yeast like cells. All samples were inoculated using calibrated wire loop (0.001 ml of urine) on Blood agar & MacConkey agar plates & incubated at 37°C for 24- 48 hours. Colony counts yielding growth of ≥105 CFU/ml of urine was regarded as significant bacteriuria. Further identification was done on the basis of morphology, characteristics of colony (size, shape, pigmentation and haemolytic nature) and gram staining. All the suspected isolates were further subcultured on nutrient agar plate for biochemical test. Gram negative bacteria were identified by performing series of biochemical tests i.e. Oxidase, catalase, indole, methyl red, urease, citrate and triple sugar iron test. Gram positive bacteria were also identified based on their catalase, coagulase and, bile esculin test. Antimicrobial susceptibility of various isolates was performed by Kirby-Bauer Disk Diffusion Method using Muller Hinton Agar (HiMedia), according to Clinical Laboratory Standard Institute (CLSI) 2022 Guideline.[12]

Statistical Analysis: Collected data were first entered into an Excel sheet and later exported to IBM SPSS 17 for the purpose of analysis.

Ethical Considerations: The study received approval from the Ethical Committee of Era's Lucknow Medical College and Hospital in Lucknow. It was carried out on a voluntary basis, with written consent obtained from each pregnant woman during an interview before collecting a urine sample. The confidentiality of all patient information and clinical histories was strictly maintained.

RESULTS

The present study was conducted in department of Microbiology in Era's Lucknow Medical Collage and Hospital. In our study we enrolled 141 pregnant women with symptoms suggestive of urinary tract infection. Total 141 clean-catch midstream urine sample of patients were collected from Antenatal Care (OBS/GYN) OPD and IPD and sent for bacteriological culture to Microbiology lab.

Table 1: Clinical symptoms of UTI in pregnant females

S.NO	SYMPTOMS	NO. OF PREGNANT WOMEN (n=141)
1	Lower abdominal pain	135 (95.7%)
2	Increase Frequency Of Urination	130 (92.2%)
3	Urinary Urgency	111(78.7%)
4	Burning micturation	101(71.6%)
5	Dysuria	60 (42.6%)
6	Fever & Chills	40 (28.4%)
7	Flank Pain	5 (3.5%)
8	Hematuria	0

Table 2: trimester wise distribution of UTI positive pregnant female

Trimester	Gastational Weeks	No Of Culture Positive Patients (N=28)	Percentage (%)
1st trimester	1-13+6 weeks	4	14%
2nd trimester	14-28 weeks	14	50%
3rd trimester	28+1- till birth	10	36%

Table 3: Uropathogen isolated from pregnant women urine samples

Uropathogen	No. Of isolates (n=28)	Percentage
Escherichia coli	15	53.6%
Klebsiella species	5	17.9%
Enterococcus species	3	10.7%
Staphylococcus aureus	2	7.1%
Proteus species	2	7.1%
Pseudomonas aeruginosa	1	3.6%

Table 4: Antimicrobial susceptibility pattern of Gram negative organisms isolated from urine samples

S. No	Antibiotics	Sensitivity			
		E.coli (n=15)	Klebsiella Species (n=5)	Proteus Speices (n=2)	Pseudomonas Aeruginosa (n=1)
1	Tigecycline	15(100%)	5(100%)	2(100%)	-
2	Colistin	15(100%)	5(100%)	-	1(100%)
3	Netilmicin	14(93.3%)	4(80%)	2(100%)	1(100%)
4	Nitrofurantoin	14(93.3%)	5(100%)	1(50%)	0
5	Amikacin	13(86.7%)	5(100%)	2(100%)	1(100%)
6	Tobramycin Sulphate	13(86.7%)	4(80%)	2(100%)	1(100%)
7	Doripenem	12(80%)	5(100%)	2(100%)	1(100%)
8	Cefoperazone+ Sublactum	12(80%)	4(80%)	2(100%)	1(100%)
9	Gentamicin	11(73.3%)	4(80%)	2(100%)	1(100%)
10	Ceftrixone	7(46.7%)	2(40%)	1(50%)	1(100%)

11	Ciprofloxacin	6(40%)	2(40%)	1(50%)	1(100%)
12	Imipenem	12(80%)	5(100%)	2(100%)	1(100%)
13	Meropenem	12(80%)	5(100%)	2(100%)	1(100%)
14	Amoxiclav	8(53.3.3%)	0	1(50%)	0
15	Pipercillin+ Tazobactum	13(86.7%)	4(80%)	2(100%)	1(100%)
16	Cefepime Hydrochloride	9(60%)	4(80%)	2(100%)	1(100%)
17	Doxycyclin	11(73.3%)	5(100%)	0	0
18	Norfloxacin	6(40%)	2(40%)	1(50%)	1(100%)

Table 5: Over all AST pattern of Gram negative isolates

S.no	Antibiotic discs	Abbrevation	No. Of isolates N=23	Sensitivity (%)
1	Tigecycline	TGC	22*	22 (100%)
2	Colistin	CL	21**	21 (100%)
3	Netilmicin	NET	23	21 (91.3%)
4	Nitrofurantoin	NIT	23	20 (86.9%)
5	Amikacin	AK	23	21 (91.3%)
6	Tobramycin Sulphate	TOB	23	20 (86.9%)
7	Doripenem	DOR	23	20 (86.9%)
8	Cefoperazone+ Sublactum	CFS	23	19 (82.6%)
9	Gentamicin	GEN	23	18 (78.2%)
10	Ceftrixone	CTR	23	11 (47.8%)
11	Ciprofloxacin	CIP	23	10 (43.4%)
12	Imipenem	IPM	23	20 (86.9%)
13	Meropenem	MRP	23	20 (86.9%)
14	Amoxiclav	AMC	23	9 (39.1%)
15	Pipercillin+ Tazobactum	PIT	23	20 (86.9%)
16	Cefepime Hydrochloride	CPM	23	16 (69.5%)
17	Doxycyclin	DO	23	16 (69.5%)
18	Norfloxacin	NX	23	10 (43.4%)

*Tigecycline was not used for Pseudomonas aeruginosa
**Colistin was not used for Proteus species

Table 6: Antimicrobial susceptibility pattern of Enterococcus species isolated from urine samples

S.No	Antibiotics	Abbreviation	No Of Isolates (N=3)	Sensitivity (%)
1	Linezolid	LZ	3	3(100%)
2	Teicoplanin	TEI	3	3(100%)
3	Ciprofloxacin	CIP	3	1(33.3%)
4	Vancomycin	VA	3	3(100%)
5	Nitrofurantoin	NIT	3	2(66.7%)
6	Doxycycline	DO	3	2(66.7%)
7	Norfloxacin	NX	3	1(33.3%)
8	High Level Gentamicin	HLG	3	2(66.7%)
9	Ampicillin	AMP	3	2(66.7%)
10	Amoxiclav	AMC	3	2(66.7%)
11	Pristinomycin	RP	3	0

Table 7: Antimicrobial susceptibility pattern of Staphylococcus aureus isolated from urine samples

S. No	Antibiotics	Abbreviation	No. Of Isolates	Sensitivity
1	Linezolid	LZ	2	2(100%)
2	Teicoplanin	TEI	2	2(100%)
3	Clindamycin	CD	2	1(50%)
4	Erythromycin	E	2	1(50%)
5	Cefoxitin	CX	2	0
6	Ciprofloxacin	CIP	2	1(50%)
7	Vancomycin	VA	2	2(100%)
8	Nitrofurantoin	NIT	2	2(100%)
9	Doxycycline	DO	2	2(100%)
10	Tetracyclin	TE	2	1(50%)
11	Amikacin	AK	2	2(100%)
12	Norfloxacin	NX	2	1(50%)
13	Gentamycin	GEN	2	2(100%)
14	Amoxiclav	AMC	2	0

DISCUSSION

The present study was carried out with the aim of identifying common bacterial agents causing UTI among pregnant females and their antimicrobial susceptibility pattern. UTIs are common problem in women, altered physiological, anatomical and hormonal changes; challenges in personal hygiene during pregnancy and other factors make the antenatal mother more prone to infection of the urinary tract.[9]

In the present study, according to table 1, among 141 pregnant females, lower abdominal pain was the

ISSN (O): 2687-5365; ISSN (P): 2753-6556

most common symptom i.e., 95.7% followed by increased frequency of urination, urinary urgency, burning micturition, dysuria, fever and chills and flank pain 92.2%, 78.7%, 71.6%, 42.6%, 28.4% and 3.5% respectively.

This is comparable with the study of Johnson B et al,[13] (2021) who conducted a study and found 97.25% females showed lower abdominal pain symptom, followed by increase frequency of urination, dysuria, urinary urgency, and fever & chills 59.5%, 55.6%, 42.2%, and 20.1% respectively.

Similarly, in a study by Dube R et al,[14] (2022) Pain in the lower abdomen was the most occuring symptom (89.4) followed by frequency of urination, burning micturition, urinary urgency, and fever & chills 75.1%, 12.9, 10.4% and 9.9% respectively.

Lower abdominal pain and urinary frequency are common in pregnant women and aren't specific indicators of UTIs, whether culture-positive or negative. Symptoms like painful urination, dysuria, fever, and urgency are more indicative of UTIs. Increased frequency and lower abdominal pain are non-specific during pregnancy due to factors like growing uterus, expanded blood volume, higher glomerular filtration rate, and increased renal blood flow.[14]

In our study, as shown in [Table 2], the proportion of pregnant women with UTI in the first, second, and third trimester was 14%, 50%, and 36%, respectively.

The study revealed symptomatic UTI was found maximum in the second trimester of pregnancy i.e. 50% (gestational age ranged between 14-28 weeks).

Findings similar to our study were reported by Dube R et al,[14] (2022) where 45.2% pregnant female had in UTI in 2nd trimester followed by Ejerssa AW et al,[4] (2021) (46%), Kayastha B et al, (2022) (40.4%).[15]

This result may be due to physiological changes of pregnancy which peaks at 22–24 weeks and continues to persist until delivery, as a result of various causes including increased bladder volume, urethral dilatation and decreased urethral tone which results in high urinary stasis and vesicoureteral reflux.[5]

Total 28 bacteria were isolated. Most of the isolated bacteria were Gram-negative organisms 23 (82.1%) while 5 (17.9%) were Gram-positive organisms.

Our finding is in line with the previous studies of Ejerssa AW et al,[4] (2021), Rizvi M et al,[16] (2011) Johnson B et al,[13] (2021) Mohamoud H et al.,(2021),[17] Gessese YA et al, (2017),[1] and Nahab HM et al, (2022),[18] in which Gram negative bacteria were the most common UTI-associated pathogens with a rate of, 90.3%, 77.3%, 76.43%, 73.4%, 69.6%, and 69% respectively.

Gram-negative bacteria, with a special attachment structure, often cause invasive urinary tract infections during pregnancy. These bacteria, primarily from the bowel, ascend to the urinary tract. Pregnant women's inadequate genital hygiene, especially after bowel movements or urination, can also promote uropathogen colonization.

Total six different species were isolated, Escherichia coli was the predominant isolate (53%, n=15) obtained from pregnant women with UTI, followed by Kleibsiella species (18%, n=5), Enterococcus species (10.7%, n=3), Staphylococcus aureus (7.1%, n=2) Proteus species (7.1%, n=2) and Pseudomonas aeruginosa(3.6%, n=1).

Escherichia coli was the predominant (n=15, 53.6%) uropathogen isolated in our study. Different studies conducted in different parts of the globe also reported similar findings to our result with respect to Escherichia coli seen in Orji O et al,[19] (2022) (49.5%), Alemu A et al,[20] (2012) (47.5%), Mohamoud H et al,[17] (2021) (46.6), Gessese YA et al,[1] (2017) (46.4%), Ejerssa AW et al,[4] (2021) (45.2%), and Rizvi M et al, (2011) (41.5%).[16]

The predominance of Escherichia coli in our and other studies is attributed to it is a commensal of the bowel. Occurrence of E. coli can also be higher due to urine stasis in pregnancy which favors E. coli strain colonization and also considered uropathogenic due to some virulence factors (P-fmbria and S-fmbria adhesions) specific for colonization and invasion of the urinary epithelium.

Our result contradicts with the study conducted in Mbarara Regional Referral Hospital Johnson B et al, (2021),[13] out of 140 isolate, Klebsiella species was found to be the most frequent Gram-negative isolate accounting, 37.41% of total isolates.

In our study Kleibsiella species was the second most common uropathogen isolated after E. coli, accounting 18% (n=5) of total isolates. Comparable findings have been reported in Orji O et al,[19] (2022) (14.4%), Mohamoud H et al.,(2021) (20.3%),[17] Taye S et al,[5] (2018) (20.5%) and Rizvi M et al,[16] (2011) (21.5%). Whereas in study of Balachandran L et al,[21] (2022) Group B streptococci (30%) were the predominant isolates, which is contradictory to our study.

Klebsiella pneumoniae, once mainly a hospital-acquired pathogen, is now a leading community-acquired uropathogen. Its rise is linked to virulent traits such as capsules, lipopolysaccharides, fimbriae, biofilm formation, and antibiotic resistance.

Enterococcus species was found predominant gram positive uropathogen which accounted about 10.7% in our study. This finding is consistent with the studies conducted by Orji O et al,[19] (2022) (12.9%) and Dube R et al,[14] (2022) (13.1%). Enterococci species can be significant agents of urinay tract infection in hospital setting, It has tropism to kidney, mainly associated with upper UTI.

In present the study Table 4 depicts the Antimicrobial susceptibility pattern of different Gram negative organisms isolated from urine samples. In our study E. coli was 100% sensitive to Tigecyclin and Colistin followed by Netlimicin (93.4%), Nitrofurontoin (93.3%), Amikacin(86.7%), Meropenem (80%), Gentamicin (73.3%),

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Doxycyclin (73.3%), Cefepime hydrochloride (60%), Amoxiclav (53.3%), Ceftrixone (46.7%) and least sensitive to Ciprofloxacin (40%) and Norfloxacin(40%).

Dube R et al,[14] (2022), in their study showed E coli was sensitive to Nitrofurantoin (92.8%), Meropenem (92.8%), Gentamicin (85.7%), Cefepime hydrocloride (78.5%) Amoxicillin/Clavulanic acid (71.4%) and least sensitive to Ceftriaxone (64.2%) and Ciprofloxacin (21.4%) which is nearly in agreement with our study. In contrast to our study, E.Coli was 100% sensitive to Ceftrixone, Ciprofloxacin and Norfloxacin in the study performed by Alemu A et al., (2012).[20]

As [Table 5] demonstrated over all AST pattern of Gram negative isolates. In our study Gram negative isolates were 100% sensitive to Tigecyclin and Colistin followed by Netlimicin (91.3%), Amikacin (91.3%), Nitrofurontoin (86.9%), Tobramycin Sulphate (86.9%), Pipercillin Tazobactum (86.7%), Doripenem (86.9%), Imipenem (86.9%), Meropenem (86.9%), Cefoperazone Sublactum (82.6%), Gentamicin (78.3%), Doxycyclin (69.5%), Cefepime hydrochloride (69.5%), Ceftrixone (47.8%) ciprofloxacin (43.4%).

In the study of Orji O et al,[19] (2022) the Gram negative isolates was 100% sensitive to Tigecyclin and Colistin followed by Meropenem (98.2%), Tobramycin sulphate (84.2%), Nitrofurantoin (81%) and Gentamicin (70.1%) which was almost revolving around our study but also showed 100% sensitive to Amikacin and Imipenem which was 91.3% and 86.9% respectively in our study.

Findings similar to our study were reported by Rizvi M et al,[16] (2011) showing sensitivity to Cefoperazone- sulbactum (92.2%) Amikacin (81.1%), Gentamycin (64.4%) ,Nitrofurantoin (80%) and least sensitivity to Ciprofloxacin (35.5%).

In the study of Taye S et al,[5] (2018) the antibiotic susceptibility test pattern showed that 90.9%, 88.6% and 86.3% of the isolates were sensitive to Amoxicillin/clavulanic acid, Gentamycin and Norfoxacin, which contrary to our study.

According to [Table 6], the Antimicrobial susceptibility pattern of Enterococcus species (n=3) isolated from urine samples was 100% sensitive to Linezolid, Teicoplanin and Vancomycin followed by Nitrofurantoin, Doxycycline, High Level Gentamicin, Ampicillin , Amoxiclav i.e. 66.7% and least sensitive to Norfloxacin and Ciprofloxacin i.e 33.3%.

In study of Orji O et al,[19] (2022) Enterococcus species showed 100% sensitivity to Vancomycin, similar to our study but also showed 100% sensitivity to Amoxiclav which is lesser in our study (66.7%). Comparable findings have been reported in thestudy of Rizvi M et al,[16] (2011) showing 100% sensitivity to Vancomycin and 70% to High level gentamicin (HLG).

According to [Table 7], Antimicrobial susceptibility pattern of Staphylococcus aureus(n=2) isolated from urine samples was 100% sensitive to Linezolid, Teicoplanin, Vancomycin, Nitrofurantoin, Doxycycline, Gentamicin, Amikacin, followed by Clindamicin, Erythromycin, Tetracyclin, Norfloxacin, and Ciprofloxacin (50%) . However 100% resistant to Amoxiclav and Cefoxitin was seen in our study.

The higher sensitivity of Gram positive bacteria in our study could be due to less number of isolates.

This study underscores the importance of regularly screening for symptomatic bacteriuria in pregnant women. It also calls for specific guidelines on testing antimicrobial susceptibility and selecting safe drugs for them. Due to increasing drug resistance in both gram-negative and gram-positive bacteria, the options for UTI treatment in pregnancy are limited.

We suggest that periodic surveys should be done for the susceptibility pattern of the common microorganism causing UTI in local regions especially for pregnant females.

CONCLUSION

Our study underscores the heightened risk of UTIs in pregnant women, potentially leading to maternal and perinatal health complications. Our six-month study involving 141 pregnant women with UTI symptoms revealed that 20% were diagnosed with symptomatic UTIs. Notably, the second trimester exhibited the highest incidence at 50%, followed by the third trimester at 36%, and the first trimester at 14%. To mitigate the impact of symptomatic UTIs and multidrug-resistant bacteria in pregnant women, it is imperative to prioritize health education, maintain ongoing pathogen surveillance, and monitor trends in antimicrobial resistance. When selecting empirical antibiotics, local pathogen prevalence and antibiotic susceptibility patterns should guide the decision-making process, with a primary emphasis on ensuring the safety of both the mother and the fetus.

Acknowledgement

We express our gratitude to the Department of Obstetrics and Gynecology, ELMC&H, Lucknow, for their support in providing the necessary samples for our analysis and for their valuable recommendations that greatly assisted in the execution of this study. Special thanks to my mentor for her continuous encouragement and guidance throughout the entire project.

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