Antimicrobial Sensitivity Profile of Samples taken from Inpatient Pregnant and Lactating Women Seeking Care in the Department of Obstetrics and Gynaecology: A Descriptive Record Based Study at a Tertiary Care Centre In Mandya

[1]Dr. T. Balasubramanian, [2]Mohammed Sinan P. A, [2]Nakul Gowda B. S, [2]Nandhini S,
[1]Professor and Principal, [2]Pharm D
[1]Department of pharmacy practice, Bharathi college of pharmacy, Bharathinagara, Mandya, Karnataka-571422.

ABSTRACT:

Antimicrobial sensitivity testing (AST) assesses how effective antimicrobials are against infections. Rising antimicrobial resistance (AMR) poses a severe global health threat, increasing morbidity and mortality, particularly among pregnant and lactating women. AMR now leads to more deaths worldwide than HIV/AIDS or malaria, even affecting previously treatable infections. This study aims to determine the antimicrobial sensitivity profile of pathogens isolated from pregnant and lactating women. The main objective of the study is to describe the antimicrobial sensitivity profile among different types of samples collected from the OBG department of pregnant and lactating women and analyse the antimicrobial sensitivity pattern for the effective treatment. In a tertiary care hospital, a Descriptive record- based study was conducted for a duration of 6 months which involved 108 Infectious Pregnant and Lactating women. The study determines the sensitivity and the resistance patterns of pathogens against the Antimicrobials used among pregnant and lactating populations that aids in the effective treatment. The present study showed that among 108 patients, bacterial cultures were most common (93.6%), followed by fungal cultures (6.45%). Pregnant women had a higher infection rate compared to lactating women. Urinary Tract Infections had a positive culture rate of 43.5%, followed by Vaginal infections at 29.7%. Major comorbidities were Anemia and Hypothyroidism. Of the isolated pathogens, 51% were Gram-negative, with Escherichia coli (30.6%) being the most prevalent, followed by Staphylococcus aureus. Antibiotic sensitivity tests showed the highest sensitivity to Linezolid, gentamicin, and vancomycin, with Cefotaxime and Nitrofurantoin also showing high sensitivity. In conclusion, the pathogens were found to be more resistant to Glycopeptides, penicillins, Macrolides, and Tetracyclines, limiting their use during pregnancy and lactation. Therefore, it's crucial to identify common pathogens and their antimicrobial sensitivity, as well as their safety for mother and foetus, to ensure effective treatment during these periods.

KEY WORDS: Antimicrobial Sensitivity, Resistance, UTI, Antibiotics.

INTRODUCTION:

Antimicrobial sensitivity testing (AST) is a method used to study the effectiveness of antimicrobials given to the patient against deadly infections. AST helps in the formulation of a profile which provides the information about the microbes, current condition of the patient and also helps in providing necessary care for the patient.[1] The Antimicrobial Sensitivity Test (AST) supports physicians in selecting the most appropriate antibiotic for an individual patient's needs and in recording epidemiological data on microbial resistance in the community.[1,2] Bacteria, fungi, viruses, and protozoa are all potential sources of infection. Bacteria were the most common pathogen among the four groups.[2] Antimicrobial resistance (AMR) is defined as the ability of bacteria to encode the resistance genes that counteract the inhibitory action of the possible antibiotics used for survival.[3]

AMR is a major public health concern in India and globally. According to WHO, antimicrobial resistance is a rising challenge in all parts of the world, leading to increased mortality and morbidity. According to WHO, an estimate of 10 million deaths will be reported by 2050 globally.

Factors such as mis and over use of antibiotics, treatments with immunosuppressants and prolonged hospitalization also contribute to the same. The SARS-CoV-2 pandemic has also increased the amount of antimicrobial resistance.[3]

Antibiotics use in pregnancy has been on the rise globally in the last decade, including during pregnancy and lactating women. The frequency of misuse of antibiotics among women of childbearing age in the developing world is much higher because of the ineffectiveness of satisfactory guidelines for antibiotics.[9] Pregnant and lactating populations may potentially be more vulnerable to infections than other patient populations. Some of the common infection among these populations are Vaginal infections, Yeast infection/ Vulvovaginal candidiasis, Group B Streptococcal infection, Urinary tract infections, Candidiasis, Respiratory infections and Mastitis. The common pathogens causing infections include, Listeria Monocytogenes, Escherichia Coli, Streptococcus, Enterococci, Staphylococcus, Campylobacter, Candida's and Klebsiella Pneumoniae.

Several studies have been conducted showing the sensitivity and resistance pattern of Antimicrobials. However, in the current scenario treatment for infections among the populations were assumed much importance. Therefore, this study is conducted to study the effective treatment plan for the Microbial infections by determining the sensitivity and resistance pattern among pregnant and lactating populations in a tertiary care hospital in Mandya. This will reflect the need for integrated treatment which will result in the decline in mortality caused due to infections.

MATERIALS AND METHODS:

An observational study was conducted which was Descriptive record-based in nature. Before the commencement of the study, approval from Institutional Ethical Committee for the research was obtained. All the Pregnant and Lactating patients attending the Obstetrics and Gynaecology inpatient department of a teaching hospital Mandya Institute of Medical Science (MIMS) during the study period of 6 months, who were diagnosed at that time with infections were chosen as subjects for the study. Sample size of 108 patients were enrolled in the study.

STUDY CRITERIA:

a) Inclusion criteria:
Records of pregnant and lactating women admitted in the OBG department of Mandya Institute of Medical Sciences, Mandya inpatients whose samples were collected for antimicrobial sensitivity testing.
b) Exclusion Criteria:
Nil.

METHOD OF DATA COLLECTION (STUDY TOOLS):

All the data relevant to the patients were collected from patient's medical record. The Patient's medical records included: socio-demographics details, diagnosis, culture sensitivity report, treatment and management.

ANALYSIS:

Descriptive statistics has been applied in the present study. To generate graphs and tables, data is entered in Microsoft Excel and Word. Simple percentage calculation will be done to arrive at conclusion for our study.

RESULTS

A total of 108 patients admitted in MIMS were enrolled in the study based on study criteria. Among those patients, 73 (67.6%) were pregnant and 35(32.4%) were lactating. Most common age group were 20-24(34.3%) years followed by 25-29(32.4%) years. Among pregnant population with respect to the Age of Gestation, most of the women were found to be in third trimester (52%). Out of 108 patients, majority of the patient presented with co-morbidities like Anemia (76.9%) and Hypothyroidism (37%). Specimens such as urine, pus, vaginal swab, sputum and blood has been collected to detect the presence of infection among the study population. Among them, urine samples (39.8%) are presented with majority of positive cultures. Distribution based on microbial culture, (93.6%) were bacterial and very few with (6.4%) fungal cultures. Among them, the most abundantly obtained species is Escherichia coli (30.6%) and Staphylococcus (27.7%) followed by klebsiella and other species. Among fungi, candida albicans were found to be the most. Based on gram staining, majority of the organisms were found to be Gram Negative about (51%) compared to that of Gram positive (48%).

Figure 1: **Distribution based on Infections**

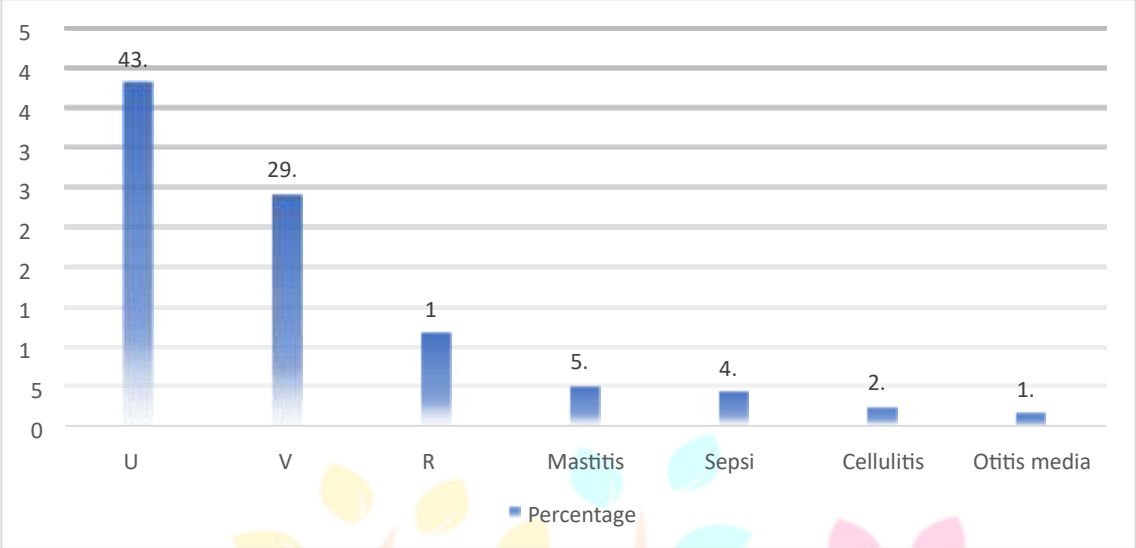


Figure 1 shows the patient distribution based on the type of infection, the most common was Urinary Tract Infection (UTI) followed by Vaginal Infection (VI), Respiratory Tract Infection (RTI), Mastitis, Sepsis, Cellulitis and Otitis media.

Table 1: **Distribution of Antibiotics based on culture sensitivity profile**

Class of antibiotic	**Drugs**	**Frequency of sensitivity**	**Percentage among classes**	**Average**	**Percentage of individual drug**
Beta lactam	Penicillin	27	10.6%		3.51%
	Ampicillin	39	15.4%		5.07%
	Oxacillin	13	5.1%		1.69%
	Cefoxitin	4	1.6%		0.52%
	Ceftriaxone	40	15.7%		5.2%
	Cefepime	10	3.9%		1.3%
	Cefotaxime	59	23.2%		7.68%
	Meropenem	7	2.8%		0.91%
	Imipenem	55	21.7%		7.16%
	Total	**254**		33.1%	
Macrolides	Erythromycin	**29**	100%	3.8%	3.77%
Lincosamide	Clindamycin	**27**	100%	3.5%	3.51%
Fluoroquinolones	Ciprofloxacin	**38**	100%	4.9%	4.94%

Aminoglycosides	Amikacin	27	30.3%		3.51%
	Gentamycin	62	69.7%		8.07%
	Total	**89**		11.5%	
Glycopeptides	Vancomycin	61	95.3%		7.94%
	Teicoplanin	3	4.7%		0.39%
	Total	**64**		8.3%	
Oxazolidinone	Linezolid	**63**	100%	8.2%	8.2%
Sulfonamides	Trimethoprim	22	43.1%		2.86%
	Co trimoxazole	29	56.9%		3.77%
	Total	**51**		6.6%	
Tetracycline	Tigecycline	7	100%	0.9%	0.91%
Polymyxin	Polymyxin B	8	32%		1.04%
	Colistin	17	68%		2.21%
	Total	**25**		3.3%	
Nitrofuran	Nitrofurantoin	**53**	100%	6.9%	6.9%
Combination	Piperacillin+ tazobactam	39	57.4%		5.07%
	Ampicillin+ sulbactam	4	5.9%		0.52%
	Amoxicillin+ clavulanate	25	36.8%		3.25%
	Total	**68**		8.9%	
TOTAL	**Antibiotics**	**768**		**100%**	**100%**

Table 1 shows that, the beta lactam antibiotics were found to be highly sensitive followed by aminoglycosides. Based on individual drugs, linezolid (63) 8.2%, gentamycin (62) 8.07%, vancomycin (61) 7.94%, cefotaxime (59) 7.7%, imipenem (55) 7.2% and nitrofurantoin (53) 6.9% were found to highly sensitive drugs. Teicoplanin (3) 0.39% and cefoxitin (4) 0.52% were found to be least sensitive antibiotics.

Figure 2: Distribution of Antibiotics based on culture resistance profile

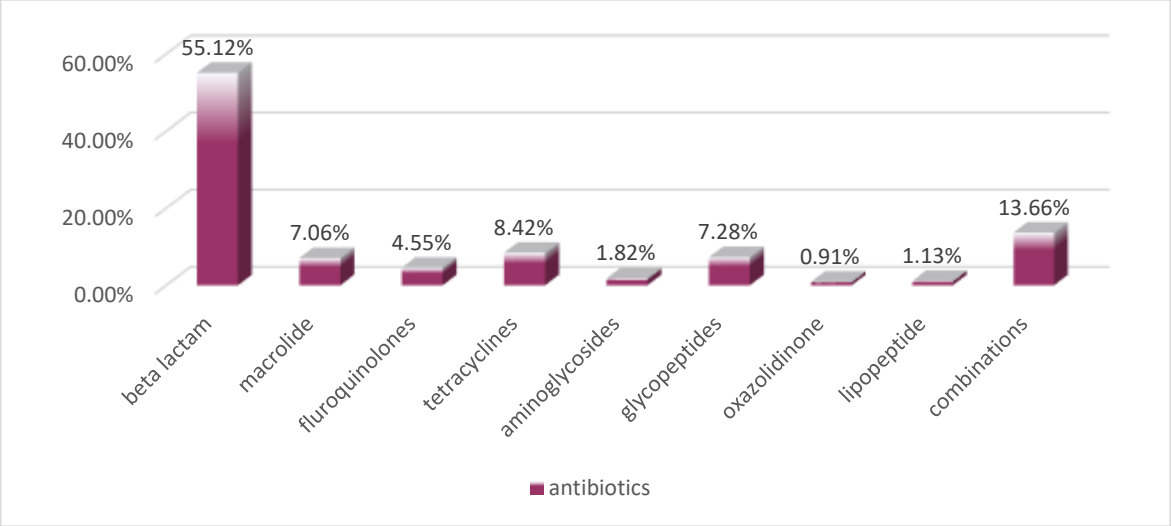


Figure 2 shows that, beta lactams were found to be highly resistant (55.12%) followed by tetracyclines (8.12%). Based on the individual drugs, ampicillin (41) 11.16%, tetracyclines (37) 8.42%, cefazolin (35) 7.97%, amoxicillin (31) 7.06% and teicoplanin (30) 6.83% were found to be highly resistant. Vancomycin and penicillin were found to be least resistant drugs (2) 0.45%.

Table 2: Distribution of Antifungals based on culture sensitivity profile

Class of Antifungal	Drugs	Frequency of sensitivity	Percentage among classes	Average
Polyenes	Amphotericin B	6	60%	
	Nystatin	4	40%	
	Total	10		22.7%
Echinocandins	Echinocandins	5	100%	11.4%
Heterocyclic benzofuran	Griseofulvin	2	100%	4.5%
Imidazole	Clotrimazole	7	58.3%	
	Ketoconazole	5	41.7%	
	Total	12		27.3%
Triazoles	Fluconazole	7	53.8%	
	Voriconazole	6	46.2%	
	Total	13		29.5%

Table 2 shows that, azoles (triazoles 29.5% and imidazole 27.3%) were found to be highly sensitive followed by polyenes (22.7%). Based on individual drug, clotrimazole and fluconazole were extremely sensitive (100%).

Figure 3: Distribution of Antifungals based on culture resistance profile

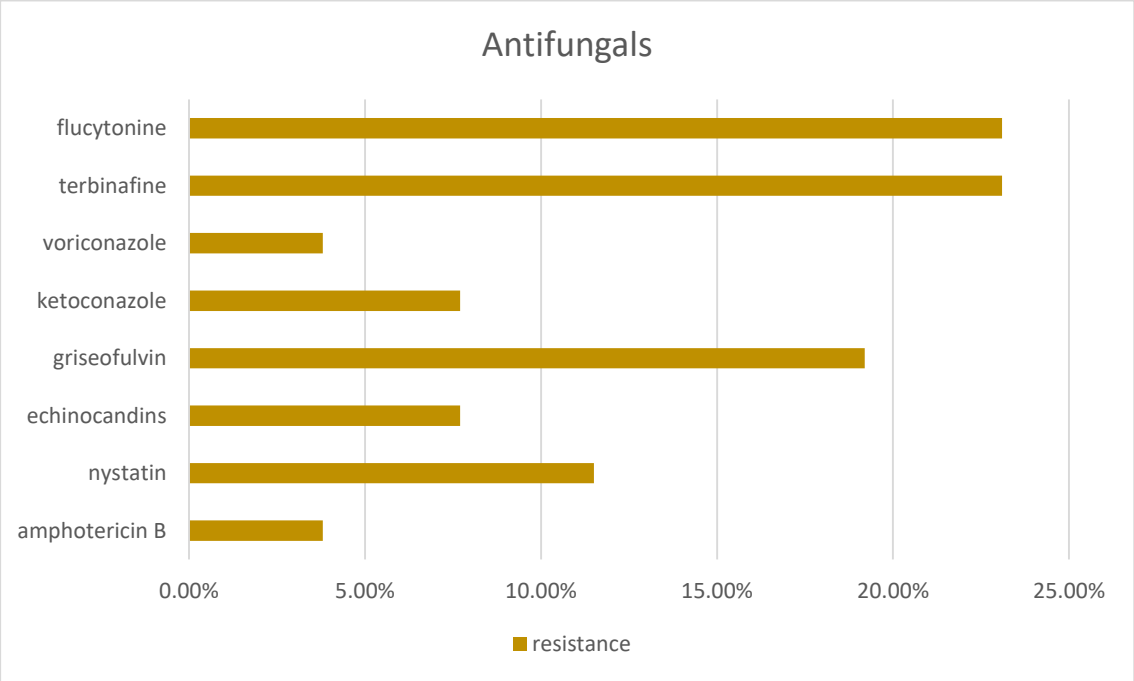


Figure 3 shows that, allylamines and pyrimidines were found to be highly resistant (23.1%) followed by benzofuran (19.2%). Based on individual drug, terbinafine and flucytosine were highly resistant among fungal species.

DISTRIBUTION OF ANTIBIOTICS FOR SPECIES TYPE

Distribution of antibiotics for Escherichia-coli based on their sensitivity and resistant pattern

Among 108 culture sensitivity data, 33 were found to be positive for Escherichia coli, for which various antibiotics are found to be sensitive and resistant. **Table 3:** Cefotaxime (96.96%), Nitrofurantoin (93.93%), cotrimoxazole (87.87%) and linezolid (87.87%) shows higher sensitivity followed by vancomycin (84.84%), gentamycin (84.84%), erythromycin (84.84%), piperacillin+ tazobactam (81.81%), ciprofloxacin (81.81%), ceftriaxone (75.75%), amoxicillin + clavulanate (75.75%), amikacin (72.72%), clindamycin (66.66%) and imipenem (54.54%).

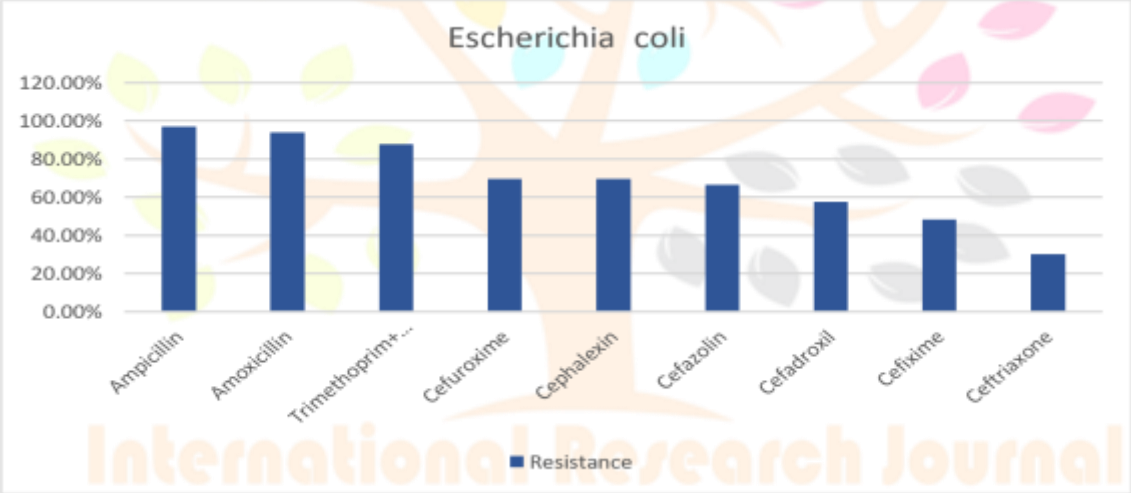
Figure 4: Ampicillin (96.96%) and Amoxicillin (93.93%) were found to be extremely resistant followed by trimethoprim+ sulfamethoxazole (87.87%). Cephalosporin antibiotics were found to be moderately resistant, among them ceftriaxone (30.30%) found to be the least.

Table 3: Distribution of sensitive antibiotic for Escherichia- coli

Sensitive drugs	Frequency	Percentage
Cefotaxime	32	96.96%
Nitrofurantoin	31	93.93%
Cotrimoxazole	29	87.87%
Linezolid	29	87.87%
Vancomycin	28	84.84%
Gentamycin	28	84.84%

Erythromycin	28	84.84%
Piperacillin+ tazobactam	27	81.81%
Ciprofloxacin	27	81.81%
Ceftriaxone	25	75.75%
Amoxicillin+ clavulanate	25	75.75%
Amikacin	24	72.72%
Clindamycin	22	66.66%
Imipenem	18	54.54%

Figure 4: Distribution of resistant antibiotic for Escherichia- coli



Distribution of antibiotics for Staphylococcus species based on their sensitivity and resistant pattern

Among 108 culture sensitivity data, 25 were found to be positive for staphylococcus aureus with 5 negative coagulase Staphylococcus, for which various antibiotics were found to be sensitive and resistant. **Table 4:** Ampicillin (100%) were the extremely sensitive antibiotic followed by the Imipenem (96%), Vancomycin (92%) and Gentamycin (92%), Linezolid (88%), Trimethoprim (88%), Nitrofurantoin (80%), Penicillin (60%), Oxacillin (52%) and cefotaxime (20%).

Table 5: Teicoplanin (100%) were the most resistant antibiotic followed by Tetracycline (80%), Methicillin (72%), Erythromycin (68%), Oxacillin (56%), Amoxicillin + Clavulanate (32%) and Daptomycin (20%) were the least resistant drugs.

Table 4: Distribution of sensitive antibiotic for Staphylococcus Aureus

Sensitive drugs	**Frequency**	**Percentage**
Ampicillin	25	100%
Imipenem	24	96%
Vancomycin	23	92%
Gentamicin	23	92%

Linezolid	22	88%
Trimethoprim	22	88%
Nitrofurantoin	20	80%
Penicillin	15	60%
Oxacillin	13	52%
Cefotaxime	5	20%

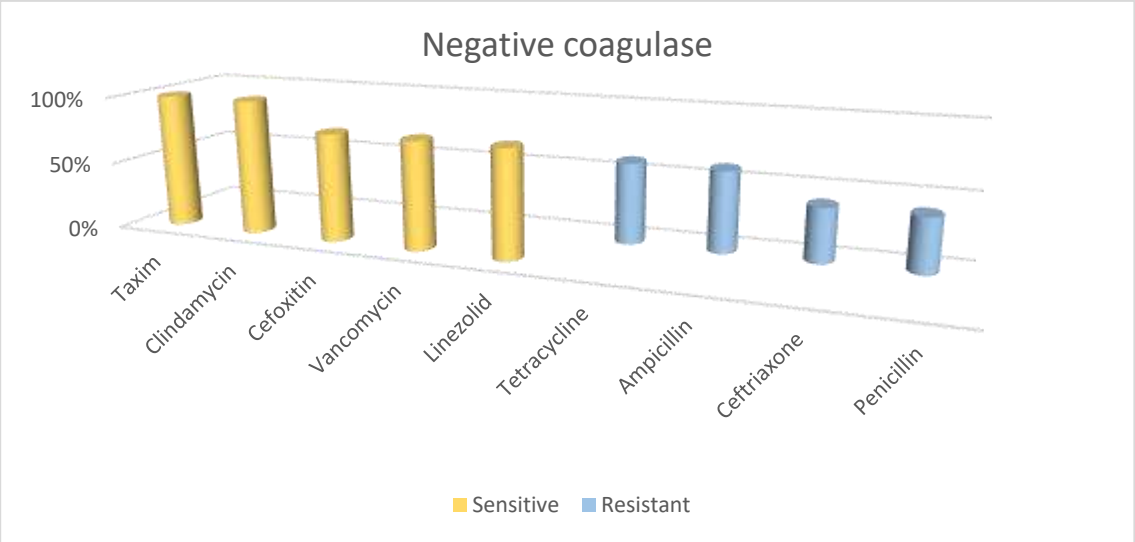
Table 5: Distribution of resistant antibiotic for Staphylococcus aureus

Resistant drugs	**Frequency**	**Percentage**
Teicoplanin	25	100%
Tetracycline	20	80%
Methicillin	18	72%
Erythromycin	17	68%
Oxacillin	14	56%
Amoxicillin+ clavulanate	8	32%
Daptomycin	5	20%

Distribution of sensitive and resistant antibiotics for Negative Coagulase Staphylococcus Aureus

Among five positive cases of negative coagulase staphylococcus aureus, cefotaxime and clindamycin were found to be highly sensitive (100%) and the resistant antibiotics were tetracyclines, ampicillin, ceftriaxone and penicillins.

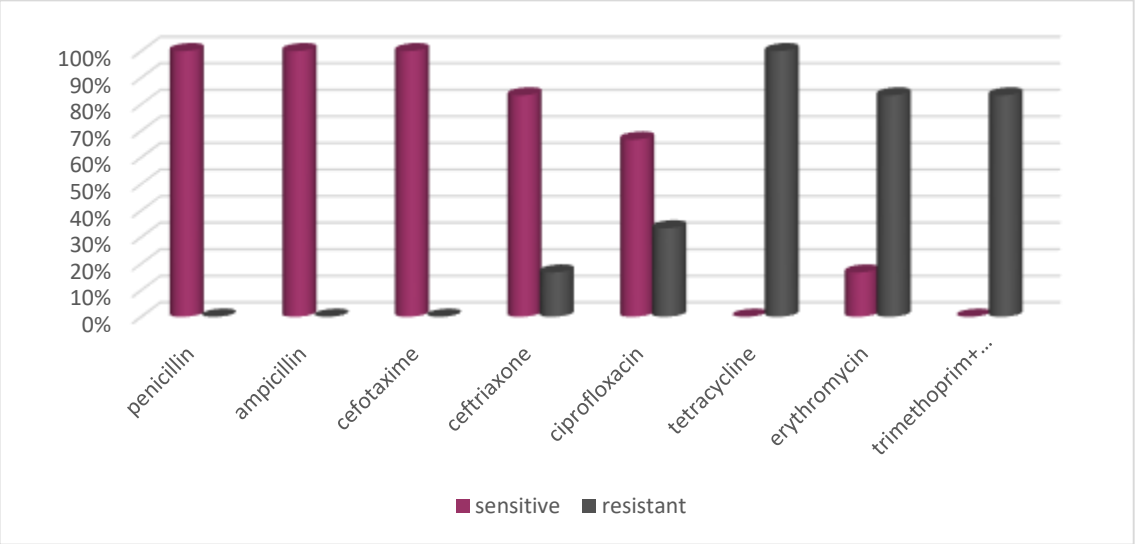
Figure 5: Distribution of Sensitive and Resistant antibiotics for negative coagulase staphylococcus aureus



Distribution of Antibiotics for Streptococcus species based on their sensitivity and resistance pattern

Among six positive streptococcus species, penicillin, ampicillin and cefotaxime were found to be extremely sensitive (100%) followed by ceftriaxone (83.33%) and ciprofloxacin (66.66%). Tetracycline (100%), erythromycin (83.33%) and trimethoprim + sulfamethoxazole (83.3%) were found to be highly resistant.

Figure 6: Distribution of Sensitive and Resistant pattern of antibiotic for Streptococcus species



Distribution of Antibiotics for other bacterial species

Among fifteen positive cases of Klebsiella species includes klebsiella pneumoniae and klebsiella oxytoca, imipenem was found to be sensitive (86.6%) followed by colistin (66.6%) and cefepime (66.6%). Ampicillin (93.3%), Amoxicillin+ clavulanate (73.3%) and cefazolin (66.6%) were found to be the most resistant followed by gentamicin, ciprofloxacin, ceftriaxone and piperacillin+ tazobactam and they were also found to be sensitive.

Among nine positive cases of Enterococcus species ampicillin and gentamicin was found to be sensitive (88.8%) followed by linezolid (77.7%) and vancomycin (66.6%). Ciprofloxacin (100%) were found to be the extremely resistant followed by Erythromycin and tetracycline.

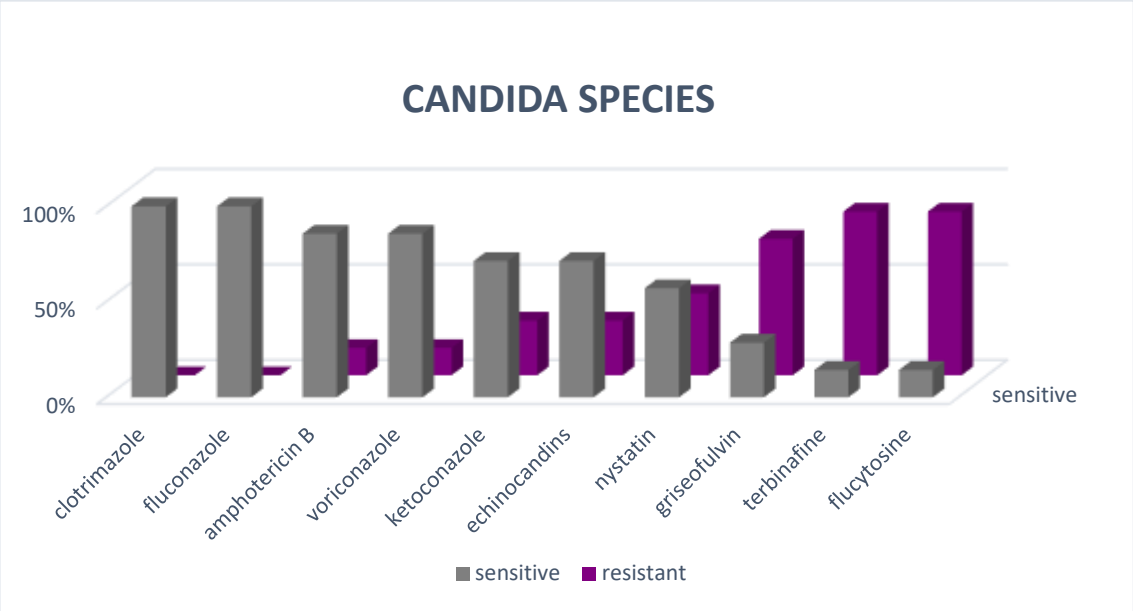
Among four positive cases of Acinetobacter species, meropenem, colistin and tigecycline were found to be extremely sensitive (100%), followed by piperacillin+ tazobactam (75%), ciprofloxacin was equally sensitive and resistant. Cefotaxime and ceftriaxone were highly resistant.

Among three positive cases of Citrobacter, carbapenems (imipenem, meropenem), polymyxin B, colistin, amikacin and tigecycline were highly sensitive. azithromycin and cephalosporins (cefazolin, Cefperazone, cefpodoxime) were found to be highly resistant.

Distribution of antifungals for Candida Species based on their sensitivity and resistant pattern

Among seven positive cases of candida species, clotrimazole and fluconazole were found to be highly sensitive (100%) followed by voriconazole (85.7%), amphotericin B (85.7%), ketoconazole (71.4%), echinocandin (71.4%) and nystatin (57.1%). Terbinafine (85.7%), griseofulvin (71.4%) and flucytosine (85.7%) were found to be highly resistant among all other antifungals.

Figure 24: Distribution of Antifungals on candida species based on their sensitivity and resistance pattern



Treatment given for the patients based on the Antimicrobial Sensitivity Profile

Among 108 patients, nearly 60 patients were prescribed with cefotaxime followed by ceftriaxone (42), metronidazole (41), nitrofurantoin (37), amoxiclav (25) and oxytocin (18) and various other antibiotics are used. Antifungals like cotrimoxazole along with pessaries were also prescribed. Patients were also prescribed with drugs based on their comorbid conditions like for Hypertension most of them were prescribed with Labetalol, Diabetes Mellitus with Insulin and Metformin, Hypothyroidism with Thyronorm, Gastritis with Ranitidine and Pantoprazole, Post-operative pain is treated with ACSP (Aceclofenac, Paracetamol and Serratiopeptidase), Paracetamol is used as a Pain-killer and various other Vitamin supplements along with Folic acid was given based on period of gestation along with Intravenous fluids.

DISCUSSION:

AMR is a major public health concern in India and globally. According to WHO, antimicrobial resistance is a rising challenge in all parts of the world, leading to increased mortality and morbidity. According to WHO, an estimate of 10 million deaths will be reported by 2050 globally. Factors such as mis and over use of antibiotics, treatments with immunosuppressants and prolonged hospitalization also contribute to the same. The SARS-CoV-2 pandemic has also increased the amount of antimicrobial resistance.

Antibiotics use in pregnancy has been on the rise globally in the last decade, including during pregnancy and lactating women. The frequency of misuse of antibiotics among women of childbearing age in the developing world is much higher because of the ineffectiveness of satisfactory guidelines for antibiotics.

The descriptive record-based study was conducted to find the appropriate treatment for the infection caused during pregnancy and lactation.

In a study of 108 women, 67.6% were pregnant, 32.4% lactating, with most aged 20-24. Among pregnant women, 52% were in the third trimester and 60.3% were primigravida. Common infections included urinary tract infections (UTI), vaginal infections, and respiratory tract infections (RTI), with UTIs being most prevalent.

Co-morbidities such as anemia, hypothyroidism, and hypertension were noted, with urine samples showing the highest number of positive bacterial cultures. Escherichia coli and Staphylococcus were the most common bacteria, primarily gram-negative. Beta-lactams had high resistance, while linezolid and gentamicin were more effective. Candida species caused most fungal infections, with azoles proving highly effective. The study highlights diverse sensitivity and resistance patterns, informing treatment strategies.

The findings revealed that pathogens were more resistant to Glycopeptides, penicillins, Macrolides and Tetracyclines which restrict their use in treating infections during pregnancy and lactation. In conclusion, common causative pathogen and their antimicrobial sensitivity pattern are to be determined along with their safety to mother and foetus for their effective treatment during pregnancy and lactation.

ACKNOWLEDGEMENT:

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CONFLICT OF INTEREST:

Nil

REFERENCES:

1. Khan ZA, Siddiqui MF, Park S. Current and Emerging Methods of Antibiotic Susceptibility Testing. Diagnostics. 2019; 9(2):49-52.

   Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6627445/

2. Birru M, Woldemariam M, Manilal A, Aklilu A, Tsalla T, Mitiku A, Tigist Gezmu. Bacterial profile, antimicrobial susceptibility patterns, and associated factors among bloodstream infection suspected patients attending Arba Minch General Hospital, Ethiopia. Scientific Reports. 2021; 11(1):15882-15887. Available from: https://doi. org/10.1038/s41598-021-95314-x

3. Gajic I, Kabic J, Kekic D, Jovicevic M, Milenkovic M, Mitic Culafic D, et al. Antimicrobial Susceptibility Testing: A Comprehensive Review of Currently Used Methods. Antibiotics. 2022; 11(4):427-430.

   Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9024665/

4. WHO. Antimicrobial resistance, World Health Organization. WHO; 2023

   Available from: https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance

5. Jeanne S. Sheffield, Jennifer L. Watts, David M. Hill, Shannon M. Clark, Gary D.V. Hankins, George D.V. Wendel Jr. Pregnancy and lactation: A review of antimicrobial pharmacokinetics. Journal of Clinical Pharmacology, 2019 59(9), 1059-1068.

6. Gabriella G. Nahum, Jennifer M. F, Ashley N. V, R. Phillips Heine, David A. E. Urinary tract infections during pregnancy. Journal of Maternal- Foetal & Neonatal Medicine, 2018 31(12), 1539-1545.

7. De la Vega, Maria del Carmen, Maria Luisa Gomez, Maria del M. T, Jose Manuel M, Cristina Gutierrez, et al. Antimicrobial resistance in breast milk: A systematic review. Nutrients, 2020 12(11), 3111.

8. Jennifer Spencer, Cindy-Lee Dennis, Ellen L. Mozurkewich, Susan R. Hess, Kathleen A. Rosenbloom. Mastitis in breastfeeding women. Journal of Human Lactation, 2019 35(2), 249-257.

9. Saeed A, Ali H, Yasmin A, Baig M, Ullah A, Kazmi A, et al. Unveiling the Antibiotic Susceptibility and Antimicrobial Potential of Bacteria from Human Breast Milk of Pakistani Women: An Exploratory Study. BioMed Research International. 2023:9-12.

   Available from: https://www.hindawi.com/journals/bmri/2023/6399699/