Section: Microbiology

Original Research Article

ANTIBIOTIC RESISTANT PATTERN OF AMONG COMMON BACTERIAL UROPATHOGENS IN A TERTIARY CARE HOSPITAL

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Abstract

Background: The aim of this study was to investigate common uropathogens and their antibiotic resistance patterns in patients admitted in the paediatric ward of JLNMCH, Bhagalpur, and Bihar. **Materials and Methods:** This was cross-sectional descriptive study. The present study was undertaken to detect the antibiotic resistance pattern of among common bacterial uropathogen in our tertiary care hospital JLNMCH, Bhagalpur, Bihar. This study was an observational study conducted in the Department of Microbiology, over a period of 1year from August 2022 to July 2023 with following objectives to detect antibiotic resistance pattern of among common bacterial uropathogen. Total 420 samples were collected. Informed consent was obtained from the subjects participated in the study. **Results:** Out of 420 patients 318 patients were detected with positive culture (75.71%) and 102 patients were detected with negative culture (24.28%). Out of 318 patients 115 patients were male (36.16%) and 203 patients were female (63.83%), showing a female preponderance. **Conclusion:** Hence, it is necessary to prescribe antibiotics under an exact surveillance in teaching hospitals as it can prevent unnecessary expenses for using inappropriate antibiotics.

INTRODUCTION

Urinary tract infection (UTI) is a common site of infection in the paediatric population. Unlike the generally benign course of UTI in the adult population, UTI in the podiatric population is well recognized as a cause of acute morbidity and chronic medical conditions, such as hypertension, renal insufficiency and morbidity among paediatric population due to inconspicuous clinical manifestations.[1] The diagnosis of urinary tract infection must be based on a positive urine culture.[2] Approximately 8% of girls and 2% of boys have, a UTI by 11 years of age. The lifetime incidence of UTI in females is about 30% compared to only 1% in males.

Approximately 75% of infants younger than 3 months with bacteriuria are male compared with only 10% between 3 and 8 months of age. After 12 months of age, UTI in healthy children is usually seen in girls.3 UTI is the most common bacterial infections ranging from asymptomatic to severe sepsis. Bacteria are the primary organisms that cause UTI. Significant bacteriuria is defined as colony count of >105 /ml of a single species in a midstream clean catch sample.[3] Effective antimicrobial therapy for UTI is important and can reduce adverse effects in patients with UTI. Therefore, there is growing concern regarding the resistance of urinary pathogens to antimicrobial agents because of the increasing number of therapeutic failure after empiric treatment. In acute infection, E. coli is the most frequent infecting organisms. But the prevalence of other antibiotic resistance organisms such as Klebsiella spp., Proteus spp., Serratia spp., Enterobacter spp. and Pseudomonas spp. are increasing in complicated UTI. Among gram - positives, S. sprophyticus, E. faecalis, S. agalactiae, S. pyogenes and S. aureus are usually prevalent which are resistant to a variety of different antibiotics. There are many types of antibiotics available for UTIs and the choice depends upon many factors including severity of infection and acute or recurrent infection.[4] The rate of resistance is very high among uropathogens and the frequency of resistance to antibiotics directly linked with the consumption of antibiotics. Often treatment of UTI is started empirically and therapy is based on information determined from the antimicrobial sensitivity pattern of the uropathogens of a given community.[5] Due to aberrant use of antibiotics in practice the prevalence of antimicrobial resistance among uropathogens has been increasing worldwide.[6,7] Distribution of uropathogens and their susceptibility to antibiotics varies regionally.

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Therefore, it becomes necessary to have knowledge of distribution of these pathogens and their susceptibility to antibiotics in a particular setting.[8,9] Unfortunately, little has been published regarding Indian scenario of the range and antimicrobial susceptibility patterns in uropathogens particularly among children. Awareness of antimicrobial resistance patterns of common uropathogens in children, according to local epidemiology, it is essential for providing clinically appropriate, cost effective therapies for UTIs. To the best of our knowledge, there is a lack of available information on bacterial agents and their antibiotic susceptibility pattern regarding paediatric UTIs.

The aim of this study was to investigate common uropathogens and their antibiotic resistance patterns in patients admitted in the paediatric ward of JLNMCH, Bhagalpur, Bihar.

MATERIALS AND METHODS

This was cross-sectional descriptive study. The present study was undertaken to detect the antibiotic resistance pattern of among common bacterial uropathogen in our tertiary care hospital, JLNMCH, Bhagalpur, Bihar. This study was an observational study conducted in the Department of Microbiology, over a period of 1year from August 2022 to July 2023 with following objectives to detect …antibiotic resistance pattern of among common bacterial uropathogen. Total 420 samples were collected. Informed consent was obtained from the subjects participated in the study.

Microbiological methods and antibiotic susceptibility testing

Samples were collected in a sterile container and sent to the laboratory by midstream, urine bag, catheter and suprapubic methods based on age and physical status of the subjects. 5% blood agar, eosin methylene blue and Mac Conkey agar (Himedia, India) were used for culture. Bacterial identification was done using conventional methods. Positive results were considered if the number of colonies of a single organism were >105 CFU. Antimicrobial susceptibility testing was performed by disk diffusion methods as recommended by clinical laboratory standard institute (CLSI) on the most prevalent gram-negative and gram- positive isolated bacteria. The following antibiotic disks (Mast, UK) were used: amikacin (30 µg), gentamycin HLG (120 µg), gentamycin (30 µg), amoxyclav (30 µg), ampicillin (10 µg), erythromycin (15 µg), ceftazidime (30µg), imipenem (10 µg), co-trimoxazole (1.25/23.75 µg), cefotaxime (30 µg), norfloxacin (10 µg), linezolid (30 µg), nitrofurantoin (300 µg), vancomycin (30 µg), meropenem (10 µg), piperacillin + tazobactam (100/10 µg), colistin (10 µg). Standard strains used for the susceptibility tents were Escherichia coli ATCC 25922, Staphylococcus aureus ATCC 25923, and Pseudomonas aeruginosa ATCC 27853. The isolates were classified as sensitive or resistant according to CLSI guidelines. Microsoft Excel was used for data compilation, analysis and preparation of chart.

RESULTS

Out of 420 patients 318 patients were detected with positive culture (75.71%) and 102 patients were detected with negative culture (24.28%). Out of 318 patients 115 patients were male (36.16%) and 203 patients were female (63.83%), showing a female preponderance.

Table 1 shows the distribution of uropathogens in patients with culture positive. Out of 420 patients 318 patients were detected with positive culture (75.71%) and 102 patients were detected with negative culture (24.28%) [Table 1].

Table 2 shows the distribution of patients according to sex. Out of 318 patients 115 patients were male (36.16%) and 203 patients were female (63.83%), showing a female preponderance [Table 2].

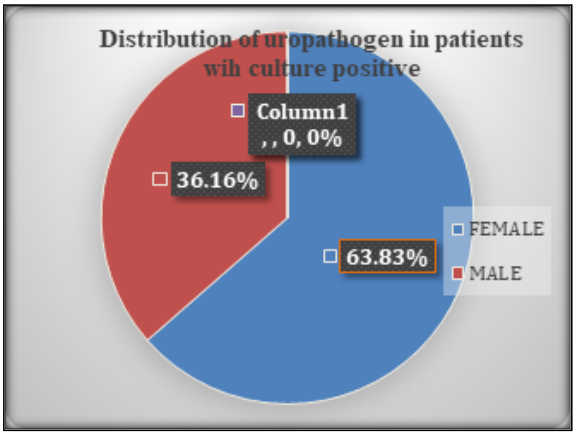

Figure 1: Distribution of uropathogens in patients with culture positive

Table 3 shows the distribution of patients according to age. Out of 318 patients 108 patients were in the age between 0-1 years (33.96%), 114 patients were in the age between 2-5 years (35.84%), 63 patients were in the age between 6-10 years (19.81%) and 33 patients were in the age between 11-15 years (10.33%). No. of patients were higher in the age group of 2-5 years (35.84%) and lower in the age group of 11-15 years (10.33%) [Table 3].

Table 4 shows the distribution of uropathogens isolated. Out of 318 cases of positive culture 135 cases were of E. coli (42.45%), 60 cases were of Enterococcus spp. (18.86%), 55 case were of Klebsiella spp. (17.29%), 32 cases were of Proteus spp. (10.06%), 25 cases were of Staphylococcus spp. (7.86%) and 11 cases were of Pseudomonas spp. (3.45%). In my study the case of E. coli (42.45%) was higher and pseudomonas spp. (3.45%) was lower among the isolated bacteria [Table 4].

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Table 1: Distribution of uropathpgen in patients with culture positive

	No. of cases	Percentage
Positive culture	318	75.71%
Negative culture	102	24.28%
Total	420	100%

Table 2: Distribution of patients according to sex

Sex	No. of patients	Percentage
Male	115	36.16%
Female	203	63.83%
Total	318	100%

Table 3: Distribution of patients according to age

Age	No. of cases	Percentage
0-1 years	108	33.96%
2-5 years	114	35.84%
6-10 years	63	19.81%
11-15 years	33	10.33%
Total	318	100%

Table 4: Distribution of uropathogens isolated

Type of isolated bacteria	No. of bacteria	Percentage
E. coli	135	42.45%
Enterococcus spp.	60	18.86%
Klebsiella spp.	55	17.29%
Proteus spp.	32	10.06%
Staphylococcus spp.	25	7.86%
Pseudomonas spp.	11	3.45%
Total	318	100%

Table 5: distribution of patients according to uropathogens

S .no	E. coli	Enterococcus spp.	Klebsiella spp.	Proteus spp.	Staphylococcus spp.	Pseudomonas spp.	Percentage
1.	37	27	16	12	12	4	108(33.96%)
2.	49	22	21	8	8	6	114(35.84%)
3.	31	7	14	8	2	1	63(19.81%)
4.	18	4	4	4	3	0	33(10.33%)
Total	135	60	55	32	25	11	318(100%)

Table 6: Antibiotic resistance pattern of gram-negative isolates

Antibiotics	E.coli (N=135)	Klebsiella spp. (N=55)	Proteus spp. (n=32)	Pseudomonas spp. (N=11)
Ampicillin/Amoxycillin	120(88.88%)	52(94.54%)	30(93.75%)	6(54.54%)
Piperacillin	12(8.88%)	2(3.63%)	4(12.5%)	4(36.36%)
Cefotaxime	42(31.11%)	4(7.27%)	16(50%)	4(36.36%)
Cephalexin	14(10.60%)	2(3.63%)	4(12.5%)	4(36.36%)
Ceftazidime	42(31.11%)	4(7.27%)	4(12.5%)	4(36.36%)
Ceftriaxone	12(8.88%)	2(3.63%)	8(25%)	2(18.18%)
Meropenem	4(2.96%)	2(3.63%)	2(6.25%)	2(18.18%)
Cefoperazone+Sulbactum	4(2.96%)	2(3.63%)	4(12.5%)	2(18.18%)
Piperacillin+Trazobactum	22(16.29%)	4(7.27%)	2(6.25%)	2(18.18%)
Gentamycin	20(14.81%)	4(7.27%)	8(25%)	0(0.00%)
Amikacin	16(11.85%)	4(7.27%)	4(12.5%)	2(18.18%)
Co-trimoxazole	48(35.55%)	12(21.81%)	1856.25%)	4(36.36%)
Nitrofurantion	40(29.62%)	12(21.81%)	4(12.5%)	6(54.54%)
Norfloxacin	46(37.07%)	2(3.63%0	10(31.25%)	2(18.18%)
Colistin	--	--	--	--

Table 7: Antibiotic resistance pattern of gram-positive isolates

Antibiotics	Enterococcus spp. (N=60)	Staphylococcus spp. (N=25)
Penicillin	44(73.33%)	4(16%)
Ampicillin/amoxicillin	38(63.33%)	8(32%)
Vancomycin	0(0.00%)	0(0.00%)
Cefoxitine	8(13.33%)	10(40%)
Gentamycin(HLG)	38(63.33%)	12(48%)
Amikacin	28(46.66%)	16(64%)
Nitrofurantion	28(46.66%)	2(8%)
Norfloxacin	56(93.33%)	20(80%0
Linezolidone	2(3.33%)	0(0.00%)
Erythromycin	30(50%)	10(40%)

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DISCUSSION

Present study showed that UTI in children was more prevalent in females than male patients. The ratio of female : male in present study was 1.8:1(63.83% females and 24.28 % males) showing a female preponderance , which is nearly similar to other study done in Coimbatore Tamil Nadu by Kavitha J et al in (59.8% females and 40.2% males) and in Bangladesh by Sanjida KS et al (61.68% females and 38.32% males).[10,11] The reason for low percentage of UTI in males is due to longer course of urethra and bacteriostatic secretions by the prostate gland which supported present study.[12,13,14] Majority of growth positive cases were in the age group of ≤6years which is higher than study done by Sumit G et al in north India.[15]

Serious study on uropathogens resistance pattern in children is broadly lacking in the state of Mizoram. The present study being an important step towards this direction in the wake of increasing reported cases of antibiotic resistance among uropathogens across the globe. E. coli (42.45%) was the commonest organism isolated in both the sex from in present study which was well correlating to other studies in India.[15,16] The second most common uropathogens isolated was Enterococcus spp. (18.86 %). Enterococcus was the most frequently isolated pathogen in the year 1996 to 2000, during a study on catheter associated UTIs in UK hospital. The researchers found that Enterococcus was the second most frequent microbe.[17] Prevalence of E. coli (40.1%) and Enterococcus spp. (19.4%) high in girls which was similar to study done by Rekha T et al.[18] Though E. coli and Enterococcus spp. were commonest uropathogens we studied other organisms as our interest is their resistance pattern like Klebsiella spp., Proteus spp., Staphylococcus spp. and Pseudomonas spp., there resistance pattern were as high as E. coli and Enterococcus spp.

The least isolated were Pseudomonas spp. (3.45%) which may be due to nosocomial infection.[19] The percentage of resistance of uropathogens to different antimicrobial agents range from 0 to 94.1% in present study. Higher resistance to antimicrobials like ampicillin, cotrimoxazole, norfloxacin, nitrofuration, cephalosporins and aminoglycosides were seen.

The resistance rates to ampicilin were found to be as high as 45%, 50% and 100% in Canada, Europe and Africa respectively.[20,21,22,23,24] In present study the frequency of resistance to ampicilin/ amoxycillin were high in all the gram negative and positive bacteria isolated except for Staphylococcus spp. (E. coli 88.88%, Klebsiella spp. 94.54%, Proteus spp. 93.75%, Pseudomonus 54.54 %, Enterococcus spp. 63.33% and Staphylococcus 32%). The use of ampicillin / amoxycillin or co-trimoxazole as an agent for empirical treatment would not cover the majority of uropathogens in Mizoram. The combination of ampicillin and an aminoglycoside are being used commonly for acute febrile illnesses of different causes in the hospital set up which may be the reason for increase resistance to ampicillin / amoxycillin by uropathogens in this part of the country. A study in Germany confirmed that initial empirical intravenous therapy of UTIs with the combination of ampicillin and aminoglycosides would be appropriate: resistance rates of causative agents to ampicillin and netilmicin were 51% and 7%, respectively.[21] In Australia, gentamicin has been proposed as monotherapy for the effective and safe treatment of UTI requiring parenteral treatment in children aged 1 month to 12 years.[24] In present study, however, resistance to gentamicin was 59.4% and 50% in Enterococcus spp. and Staphylococcus spp respectively though the resistance rate was low among the gram negative uropathogens in present study. In the area covered in this study the common uropathogens have less resistance rate to amikacin (E. coli 12.3%, Klebsiella spp. 5.3%, Proteus spp. 11.8% and Pseudomonus spp. 20%) compared to other antibiotics so it is quite safe to use as empirical treatment in the state for UTI before the culture reports are out provided that there are contraindications to use the drug in the hospitalised patients. Varying percentages of resistance to cephalosporins by both the gram negative and positive uropathogens isolated was observed in this study coinciding with the study done by Rekha T et al.[18] The reason for high resistance to cotrimoxazole is due to the fact that it has been the commonest drug for treating any acute febrile illnesses in the villages and interior part of the state.

Most of the children with suspected lower UTI are initially treated with co-trimoxazole or oral cephalosporins as first line before culture or where urine culture sensitivity cannot be performed. Due to the reasons outlined above there is moderately high resistance to co-trimoxazole by the gram negative urothopathogens in our state (E. coli 36.95%, Klebsiella spp. 15.8%, Proteus spp. 52.9% and Pseudomonas spp. 40%).

We therefore suggest that unless the uropathogen culture is positive for this drug it should not be used as first line of treatment for UTI to cut down the resistance rate of this drug in the state. Similar study in part of north India found that there were resistance to co-trimoxazole by gram-negative uropathogens in children (E. coli 35.55%, Klebsiella spp. 21.81%, Pseudomonus spp. 56.25% and Proteus spp. 36.36%), which is lower in comparison to present study.[15]

In present study Staphylococcus spp. showed zero resistance to linezolid which is similar to the study done by Rekha T et al.18 Enterococcus spp. has zero resistance to vancomycin and showed some resistance to linezolid (3.1 %) which coincides with the study done by Marwan O et al showing 100% sensitivity to these to drugs by Enterococcus spp.[25]

We found that there is zero resistance to colistin by Pseudmonas spp. conforming to a study done by Marwan O et al in 2017 among age group 1year to 97 years.[24] though there is high resistance to ampicillin

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/ amoxycillin (60%) and nitrofurantion (60%) which is more compared to study done by Sumit G et al.[15] The resistance rate to norfloxacin by gram negative uropathogens is quite low compared to previous study done by Rehkha T et al.[18]

The review of the patients' data showed that the most common antibiotics, which was prescribed by physicians for hospitalised children with UTI before obtaining culture were aminoglycosides and ceftriaxone though most effective antibiotics found in the present study meropenem and vancomycin (gram negative - meropenem and gram positive-vancomycin).

CONCLUSION

Even though Mizoram is a small state of North East India, there are many resistant strains of uropathogens which shows the necessity for doing culture sensitivity before starting antimicrobials in UTI paediatric patients. Hence, it is necessary to prescribe antibiotics under an exact surveillance in teaching hospitals as it can prevent unnecessary expenses for using inappropriate antibiotics. This will further prevent the resistant strains in the study area.

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