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Bacterial Profile and Antibiotics Susceptibility Pattern of Isolates from Urine Culture of Children with Urinary Tract Infection

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Author`s Contribution

[1]Substantial contributions to the conception or design of the work; or the acquisition, Drafting the work or revising it critically for important intellectual content [2,3]Active participation in active methodology, analysis, or interpretation of data for the work

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ABSTRACT

Objective: We conducted a study to know the local Bacterial Profile and Antibiotics Susceptibility Pattern of Isolates from Urine Culture of Children with urinary Tract Infection.

Methodology: It was a descriptive cross-sectional study on children up to 16 years of age with UTI, during the period of October 2022 to April 2023. The recorded variables were demographic. Data was recorded from computer records and presented as frequency.

Results: Out of 134 children, 94(70%) were females. Escherichia coli (E.Coli) 84(63%) was the commonest isolate followed by Enterococcus sp. 30(22%) and Klebsiella sp. 14(10%). Enterococcus sp was mostly isolated from less than one year of age, 13/30 (43%), while E.coli was mostly isolated from 1-8 years of age, 38/84(45%). E.Coli was sensitive to Fosfomycin (93%), the Carbapenems (92%) Aminoglycosides (78%) and Nitrofurantoin (78%). The antibiotic showing highest sensitivity, in case of Enterococcus was, Linezolid (100%) followed by Vancomycin (95%) and Fosfomycin (65%). Our study shows increased resistance to third generation cephalosporins. Klebsiella sp. was the most resistant one, showing less than 50% sensitivity to most of the antibiotics.

Conclusion: The urinary tract infections (UTI) in children are highest with E. coli followed by Enterococcus, Klebsiella and Pseudomonas. According to our results Imipenem, Amikacin, Nitrofurantoin, Meropenem and Cefoperazone-sulbactum are the best options for selecting empirical antibiotics for the treatment of the most common pathogen that is E.coli for suspected UTI in children in our regional area. Generation of local antibiograms should be on regular basis. The definitive therapy should be initiated only after culture and antibiotic susceptibility testing.

Key words: Bacterial Profile, Antibiotics Susceptibility, Urine Culture, Children, urinary Tract Infection

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Introduction

Urinary tract infection (UTI) is prevalent among children. To avoid long-term effects, early diagnosis and proper antibiotic administration are crucial[1]. An antibiotic susceptibility testing (AST) determines effective antibiotics and creates an empiric therapy profile. Thus, early testing is crucial in the management of infections.[2]

Majority of UTIs are caused by bacteria that initially colonize the area around the urethra before spreading to the rest of the urinary system. Lower urinary tract infections can also extend to the upper urinary tract[3] and even beyond to the surrounding tissues and bloodstream. This is particularly significant in youngsters because they might be caused by congenital abnormalities of the urinary tract. These can result in recurring infections that harm the urinary tract if not treated timely.[4] Inadequate antibiotic medication is most frequently to blame for the recurrence. While some non-antibiotic prophylactic interventions for UTI have been suggested[5], local antibiograms are needed for long term prophylaxis. In these situations, an infection typically clears itself after switching therapies in accordance with antibiotic sensitivity identified by appropriate urine cultures. As patterns of bacterial profile and resistance to antibiotics differ age and area wise [6] so up to date local patterns must be known to select an appropriate antibiotic empirical treatment. However, urine must always be

taken for culture before starting an empirical treatment, so the Objectives of our Study was to determine the local bacterial profile and antimicrobial susceptibility of isolates from urinary tract infection in children.

Methodology

This descriptive, cross-sectional study was conducted in the Department of Microbiology at Dr. Akbar Niazi Teaching Hospital, Islamabad, over a period of seven months, from October 2022 to April 2023. The study population comprised children under the age of 16 years who had positive urine cultures during the specified period. Inclusion criteria included all patients below 16 years of age with confirmed positive urine cultures. To avoid duplication, multiple cultures from a single patient were excluded from the study. The sample size was calculated using the OpenEpi sample size calculator, with a confidence level of 95%. Based on an estimated population size of 200 over six months, the required sample size was determined to be 134 participants. A non-probability sampling technique was employed, and data were collected retrospectively from computer records available in the microbiology department.

Results

The study conducted at Microbiology department ANTH included 134 children with positive urine cultures. There were 94(70%) girls and 40(30%) boys. Figure 1 shows the type of Pathogens isolated, the most common being *Escherichia coli* with a frequency of 84(63%) followed by *Enterococcus* 30(22%) and *Klebsiella* 14(10%), Pseudomonas4(3%) and Citrobacter2(2%).

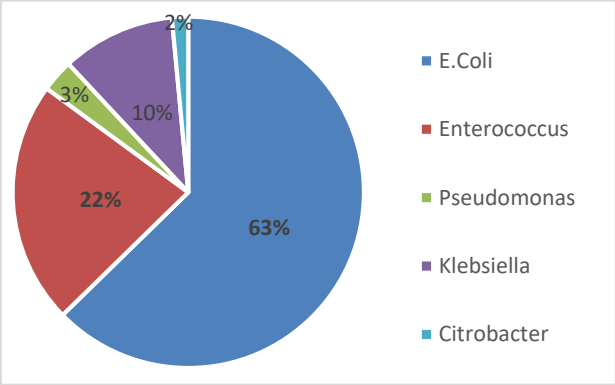

Figure 1. Types of Pathogens.

Enterococcus was mostly isolated from below one year of age, 13/30 (43%), while E.coli was mostly isolated from 1-8 years of age, 38/84 (45%) but it was not found statistically significant, as shown in Table I.

Table I: Age wise frequency of isolated Pathogens.

	Up to 1 yr	1 to 8	8 to 16	Total	p-value
E.Coli	16 (19%)	38 (45%)	30(36%)	84(63%)	0.065
Enterococcus	13 (43%)	7 (24%)	10 (33%)	30 (22%)	
Klebsiella	5 (36%)	6 (43%)	3 (21%)	14 (10%)	
Total	34	51	43	128	

Gender wise frequency of types of isolates showed equal distribution, as shown in table II.

Table II: Gender wise frequency of isolated Pathogens.

	Male	Female	Total	p-value
E.Coli	24(28.6%)	60(71.4%)	84	0.9
Enterococcus	9(30%)	21(70%)	30	
Klebsiella	5(35.7%)	9(64.3%)	14	
Total	38	90	128	

E.Coli was mostly sensitive to Fosfomycin (93%), the Carbapenems (92% to Meropenem & 89% to Imipenem), Aminoglycosides (78% to Amikacin, 61% to Gentamicin), and Nitrofurantoin (78%). The sensitivity to the combination agents Piperacillin-Tazobactum and Cefoperazone-Sulbactam was also good. It was very low to Co-amoxiclav (13%), Ceftriaxone (17%), Cotrimoxazole (23%) and Ciprofloxacin (31%).It was nil to Ampicillin. (Figure 2)

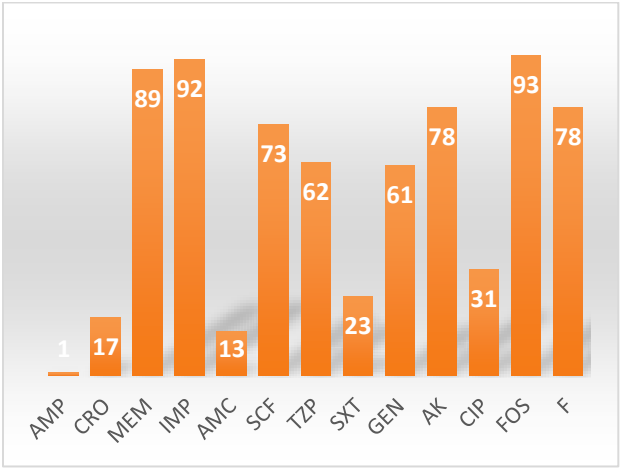

Figure: 2 Sensitivity of E.Coli

(Amp=Ampicillin, CRO=Ceftriaxone, MEM= Meropenem, IMP= Imipenem, AMC= Amoxicillin/clavalunate, SCF=Cefoperazone/sulbactum, TZP=Tazobactum/piperacillin, SXT=Trimethoprim /sulfamethoxazole, GEN=Gentamicin, AK=Amikacin,CIP=Ciprofloxacin, FOS=Fosfomycin, F=Nitrofurantoin)

The antibiotic showing highest sensitivity, in case of Enterococcus was, Linezolid (100%) followed by Vancomycin (95%). Fosfomycin also showed good sensitivity of 65%. However, Enterococcus was quite

resistant to the rest of the antibiotics tested as shown in figure 3.

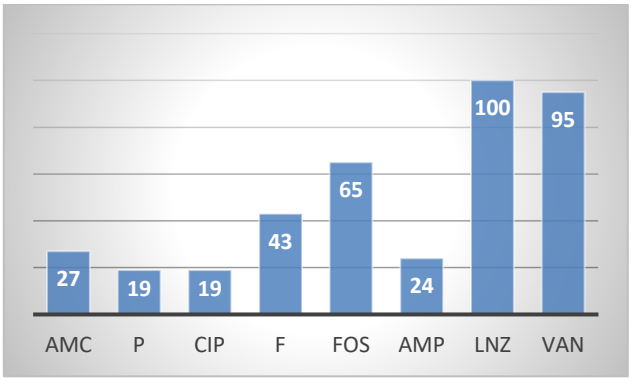

Figure 3. Sensitivity of Enterococcus.

Klebsiella species was the most resistant one, showing only less than 50% sensitivity to most of the antibiotics. Only Tazobactam-Piperacillin and Imipenem showed a sensitivity of 57% and 67% respectively. (Figure 4)

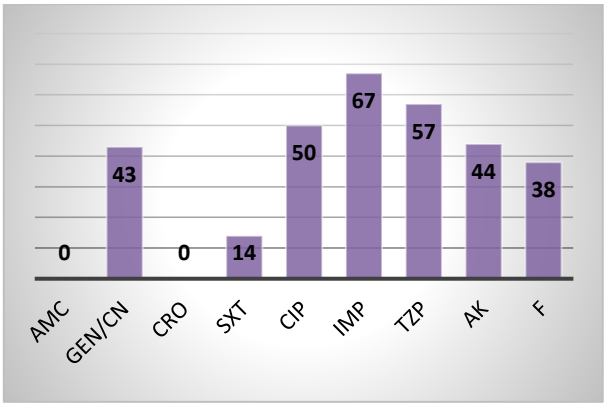

Figure 4. Sensitivity of Klebsiella species.

The number of isolates of Pseudomonas and Citrobacter were too low to draw any conclusion.

Discussion

UTI is one of the most common infections in childhood and Physicians should know the resistance patterns of commonly isolated bacteria especially in areas where they have to treat patients empirically. This study included 134 patients who were already diagnosed with urinary tract infection and were sent for culture and sensitivity to Dr. Akbar Niazi Teaching Hospital, Pakistan. Among them 70% were girls and 30 % were boys. The age range of the children was 0-16 years.

According to a recent study conducted in India[8], *E. coli* (70.3%) was the commonest isolated organism followed by *Klebsiella sp.* (15.6%) and *Pseudomonas sp.* (7%) respectively. Most of the organisms showed sensitivity to amikacin, followed by the 3rd generation cephalosporins. For *E. coli* the sensitivity was 39 (86.6%), 10 (22.2%), four (8.8%) and one (2.2%) to amikacin, third generation cephalosporins, meropenem and cefepime, respectively.

A Nigerian study [9] on bacterial profile of paediatric UTI showed *Escherichia coli* to rank highest (32.6%) followed by *Klebsiella spp*. (18.5%) *Citrobacter* and *Staphylococcus aureus* (13%) *Proteus* (12%), Pseudomonas (9.8%), Enterobacter (6.5%) and the least isolated was *Enterococcus fecalis* (1.1%). The gender distribution showed higher rate in girls. The highest positive result was obtained in children between 0-5 years. All isolates of Escherichia coli were 100% sensitive to Imipenem, second best was Nitrofurantoin (86.7%) then Ceftriaxone (73.3%), Levofloxacin (66.7%) and Ciprofloxacin (60%) while the sensitivity was very low to Augmentin (33%), Cefuroxime (27%), Gentamycin (40%) and it was 0% to Amoxicillin.

In a study in Tanzania [10] on 152 neonates with clinical sepsis, Klebsiella pneumoniae 64.3% (18/28) and Enterobacter spp. 35.7% (10/28) were the bacterial agents isolated. The bacterial profile was different from ours because the study involved only neonates. In our study too Klebsiella was isolated more in tne first year of life as compared to the older children [5(36%) v 3(21%)]. The majority of their neonates were females (59.9%). Both the isolates were 100% resistant to commonly used drugs such as, gentamicin and ceftriaxone and the susceptibility to ciprofloxacin, amikacin, nitrofurantoin and meropenem was also not very high esp. for Klebsiella where it was 44,28,33 and 28% respectively. But Enterobacter was quite sensitive to Ciprofloxacin (90%) and Amikacin (60%).

Another study of the same country [11] also showed the most common bacterial species as Escherichia coli 34 (42.5%), followed by Klebsiella spp 32 (40%), and Streptococcus spp 4 (5%) while Staphylococcus aureus, Proteus mirabilis and unidentified coliforms caused 3 (3.8%) each. Isolates had high resistance to amoxicillin 79 (98.7%), trimethoprim-sulfamethoxazole 77 (96.2) and ampicillin 76 (95%), moderate resistance to nitrofurantoin (20%) and least resistance against amikacin 6 (7.5%). In another study [12] Children below 12 months of age had a higher rate of UTI than those 12 months and above. *Escherichia coli* is again the commonest organism causing urinary tract infections in children in Kuwait [13] (67.3%), followed by *Klebsiella pneumoniae* (8.9%), *Enterococcus* (7.4%) and Proteus

species (5.7%). In this study, it was found that *Enterobacterales* showed high rates of resistance to ampicillin, cephalothin, nitrofurantoin, amoxicillin/clavulanic acid, and trimethoprim-sulfamethoxazole. Meropenem, Amikacin, Gentamicin, and Piperacillin/Tazobactam were the most effective antibiotics tested against gram-negative pathogens. In our investigation Enterococcus was the second most common species isolated. On comparing its sensitivity profile with those from the Kuwait side it was the same being highly sensitive to Linezolid and Vancomycin. But contrasted for Penicillin and Nitrofurantoin, the Kuwaiti side showed it to be highly susceptible to both the drugs while ours was very low.This may be due to the reason that ours was a small scale study as compared to theirs which concluded a five year data. We also found a good response to Fosfomycin which was not tested in the their study.

Going towards the African continent,the story is not very different with E. coli predominating again (39.4%) but the difference was that the second and third positions were occupied by Staphylococcus aureus (26.3%), and Pseudomonas aeruginosa (14.1%) which was not so in our case.[14] Another difference from our findings was that the third generation cephalosporins: ceftriaxone (90.1%) and cefadroxil (85.4%) were found to be the most effective, which again shows the importance of local generation of antibiograms. In a study done on children with congenital malformations[15] of the urinary tract the distribution of uropathogens was Escherichia coli (38.84%), Klebsiella spp. (21.15%), Enterococcus spp. (15.76%), Proteus spp. (8.07%), Pseudomonas spp. (8.07%), Enterobacter spp. (2.3%), with the Gram-positive bacteria being 3.4% only. High antibiotic resistance was detected for ampicillin, amoxicillin, and second-generation cephalosporins. Escherichia coli presented high resistance for cefepime and ceftriaxone. Vancomycin, teicoplanin, linezolid, and piperacillin/tazobactam remained effective against the Gram-positives.

The situation within Pakistan is also the same. In a study at Karachi [16] Female children suffering from UTI were in majority 103 (59.2%) as compared to males. The most common bacterial pathogen was Escherichia Coli 74 (42.5%) and Klebsiella Pneumoniae 59(33.9%) followed by Proteus 24(13.8%), Pseudomonas Aeruginosa 13 (7.5%),and Staphylococcus Aureus 04 (2.3%). Another study in Multan[17] showed sensitivity of E.Coli to be (93.2%) for Meropenem and Cefoperazone/Sulbactam, Imipenem(91.9%), Fosfomycin (89.2%), amikacin (77.0%) and nitrofurantoin (74.3%).

This is almost the same as our findings, but there was a marked difference in the sensitivities of Amoxicillin/clavulanate (75.7 v 13%) and Ceftriaxone (58 v 17%) being much better than ours. This was probably due to the fact that the Multan study included children upto 7 years of age only. A study in Lahore [18] added *Enterobacter* to the list of organisms isolated from cases of UTI. This difference may be due to the type of population which were mainly infants in this study.

So finally as compared to all other studies, our recent study in Akbar Niazi Teaching Hospital is showing the same results with minor differences. Our study shows that the Urinary tract infections are common and higher in girls (73%) as compared to boys (26%). Like other studies our study also shows that *E. coli* is the commonest pathogen (56%) as compared to other pathogenic isolates like *Enterococcus*(24%), *Klebsiella* (15%) and *Pseudomonas* (3%). The susceptibilty pattern of the isolates were different than some previous international studies but one more thing noticeable is that the overall resistance rates of antibiotics are very high in our country as compared to the rest of world[1]. The reason for this is over the counter availability and excessive use of antibiotics.

However the number of isolates are not enough to make an antibiotic policy. Further studies are required for the said purpose.

Conclusion

The urinary tract infections (UTI) in children are highest with *E. coli* followed by *Enterococcus*, *Klebsiella* and *Pseudomonas*. According to our results Imipenem, Amikacin, Nitrofurantoin, Meropenem and Cefoperazone-sulbactum are the best options for selecting empirical antibiotics for the treatment of the most common pathogen that is *E.coli* for UTI in children. Generation of local antibiograms should be on regular basis. The definitive therapy should be initiated only after culture and antibiotic susceptibility testing. In addition, antibiotics should undoubtedly be prescribed with caution. This would help in combating antibiotic resistance among bacteria and implementation of antibiotic stewardship program.

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