Original Article

Antibiogram in ICU with UTI

Antibiogram of Bacterial Organism Isolated from Patients Admitted in ICU with Urinary Tract Infection

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ABSTRACT

Objective: Identification of causative organism in severe urinary tract infectionsand their susceptibility to antibiotics which will make empirical therapy much easier to perform.

Study Design: Cross sectional study

Place and Duration of Study: This study was conducted at the Medical ICU, Pakistan Ordinance Factories Hospital, Wah Cantt from 1st June 2020 to 31st December 2021.

Materials and Methods: One hundred patients were enrolled. Samples were taken from blood and urineof the patient with severe UTI and sent to microbiologist for culture and sensitivity reports.

Results: The mean age was 59±15.5years. Forty three were females and 57 were males. Thirty two died and 68 were shifted out. 28 were diagnosed with pyelonephritis, 54 urosepsis and 18 obstructive uropathy. Forty nine were E. colipositive, 27 Klebsiella pneumoniae, 13 Pseudomonas aeuriginosa, 5 Klebsiella oxytoca, 3 Proteusmirabillis and remaing 3 were serratia marcescens positive. Ciprofloxacin was sensitive in 25 patients, amikacin in 38 patients, piperacillin/tazobatam in 25 patients, cefoperazone/sulbactum in24 patients, imipenem and meropenem in 34 and 23 patients respectively. Moxifloaxacin in 27 patients, nitrofutantoin 33 patients, colistin 55 patients and tigecycline in 36 patients were noted.

Conclusion: High levels of antibiotic resistance are seen among all gram negative bacterial isolates. Presence of elevated resistance to multiple drugs is anindicator for high prevalence of multi-drug resistant organisms, so proper identification oforganism in order to ascertain administration of emperical drugs most effective against the isolated organism is recommended in severe cases.

Key Words: Antibiogram, Bacterial isolate, Pneumonia, Sensitivity

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INTRODUCTION

Urinary tract infections are the most common cause of infection in developing countries. Worldwide there is increasing trend in hospitalization due to UTI. For the guidance of long term antibiotic selection, it is paramount to identify proper offending organisms and their antibiotic sensitivity.[1-3]

Irrespective of gender, socioeconomic status and age that disease may affect anyone.[4]

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Organism identification is necessary, and termed as major problem for infection control; as over the past two decades multi drug resistant organisms are rapidly emerging.[5, 6]

Gram-negative bacteria are the most common cause of them all; mostly E. coli is responsible for UTIs. Other organisms include Klebsiella spp., Proteus mirabilis, Pseudomonas aeruginosa, Acinetobacter spp., and Serratia spp. and Gram-positive bacteria such as Enterococcus spp. and Staphylococcus spp.[7,8] Since introduction to UTI chemotherapy drug resistance among these bacteria has increased.[9] Multidrug resistant bacteria becoming an issue for clinicians worldwide as they are putting decades of research in medical field at stake, by limiting the therapeutic array of drugs, both in community acquired and nosocomial infections.[10]

Till 2050 these infectious diseases may cause 10 million deaths becoming 2nd leading cause of mortality reported by O'Neill.[11] The risk of UTIs has increased for diabetics according to current studies; may amplified resistance rates in urinary pathogens.[12] It has been observed that 30 -50% of antibiotics prescribed in hospital practice are for surgical prophylaxis and 30–

90% of these prophylaxes are inappropriate. Pathogen drug resistance is favoured by inappropriate use of antibiotics causing complication in choice of empirical antimicrobial agents selection.[13]

MATERIALS AND METHODS

This cross sectional study was carried out after approval of ethical committee at Medical ICU, Pakistan Ordinance Factories Hospital, Wah Cantt from 1st June 2020 to 31st December 2021. A total of 100 patients, selected by non-consecutive probability sampling, of both gender, age >18 years, presenting with severe urinary tract infection symptoms and yielding bacterial growth were included in study. Patients with age <18 years, no bacterial growth on culture report and those who were already taking antibiotics were excluded from study. Informed consent was taken from every patient before inclusion in the study. Samples were taken from blood and urine of the patient with severe UTI and sent to microbiologist for culture and sensitivity reports. 1-3 ml of blood sample and 5 ml of urine sample was taken for that purpose.

The specimens were inoculated on appropriate culture medium like cysteine lactose electrolyte deficient agar (urine) and incubated at 35-37˚C under aerobic conditions for 24 hours. After overnight incubation, the agar plates were examined for growth of bacteria and their colonial morphology. The Gram-negative rods were identified based on Gram staining, catalase test, oxidase test and motility. Microbact Gram-negative 24E identification kits were used for confirmation of isolates.

The bacterial suspensions of isolates equivalent to 0.5 McFarland standard turbidity were applied on Mueller-Hinton agar. The antimicrobial susceptibility tests were performed by modified Kirby and Bauer disc diffuse methods. The susceptibility results were interpreted as sensitive, intermediate and resistant according to recommendations of clinical laboratory standards institute. The results of culture were reported by the Department of Microbiology within 5 days. All the data was entered and analyzed in SPSS-21. Association of antibiotic sensitivity pattern and type of organism was determined by Chi-square test. P-value <0.05 was considered significant.

RESULTS

There were 43 females and 57 were males. Nine were below the 35 years, 2 were between 35-44 years, 19 were between 45-54 years, 31 were between 55-64 years, 22 were 65-74 years, 13 were 75-84 years and 4 were greater than age of 85 years with mean age was 59±15.5 years. Thirty two were died and 68 were shifted out. Twenty one patients had positive blood culture and 79 had urine culture. Twenty eight were diagnosed with pyelonephritis, 54 were diagnosed with urosepsis and 18 were diagnosed with obstructive uropathy. Forty nine patients had infection due to E. coli bacteria, 27 due to Klebsiella pneumoniae, 13 secondary to pseudomonas aeuriginosa, 5 were klebsiella oxytoca positive, 3 due to proteus mirabillis and remaing 3 were serratia marcescens positive respectively (Table 1).

Ampicillin sensitivity was present in 2 patients, cotrimoxazole 6 patients and co-amoxiclave 5 patients. Ciprofloxacin was sensitive in 25 patients, gentamicin in 8 patients and amikacin in 38 patients, while cefotaxime sensitivity was seen in 5 patients, ceftriaxone in 4 patients, piperacillin/tazobatam in 25 patients and cefoperazone/sulbactum in 24 patients. Similarly; high sensitivity in imipenem and meropenem was seen i.e. 34 and 23 patients respectively. However low sensitivity was reported in tetracycline (6 patients), ceftazedime (7 patients), cefoperazone (4 patients) and levofloaxacin (4 patients). High antibiotic sensitivity was reported for moxifloaxacin in 27 patients, nitrofutantoin 33 patients, colistin 55 patients and tigecycline 36 patients (Table 2).

Frequency statistics of antibiotics sensitivity for gram - ve organism showed that E. coli was highly resistant against ampicillin, cotrimoxazole, co-amoxiclave, gentamicin, cefotaxime and ceftriaxone, however improved sensitivity was recorded or amikacin (30.6%), ciprofloxacin (26.5%), piperacillin-tazobactam (26.5%), cefoperazone-sulbactum (28.5%), imipenem (34.6%) and meropenem (22.4%). Similarly, high resistance was seen against tetracycline (93.8%), ceftazidime (91.8%), levofloaxcin (94.9%) and cefoperazone (94.9%). However improved sensitivity was seen for moxifloaxacin (20.4%), colistin (61.2%), nitrofurantoin (40.8%) and tigecycline (44.9%). Klebsiella Pneumoniae was highly resistant against cotrimoxazole, co-amoxiclave, ciprofloxacin, gentamicin, cefotaxime, ceftriaxone, piperacillin/ tazobactam and cefoperazone- sulbactam. However; improve sensitivity was recorded for amikacin (48.1%), moxifloaxacin (33.3%), imipenem (44.4%) and meropenem (29.6%). Similarly, high resistance was seen against tetracycline, ceftazidime, levofloaxcin, cefoperazone and nitrofurantoin. Improved sensitivity was seen for colistin (59.5%) and tigecycline (40.7%). Pseudomonas aeruginosa was highly resistant against all antibiotics except moxifloaxacin (38.4%), colistin (61.5%) and nitrofurantoin (53.8%). Klebsiella oxytoca was highly resistant against all antibiotics except ciprofloxacin (60%), amikacin (100%), nitrofurantoin (80%) and Piperacillin/tazobactam (40%). Proteus Mirabillis was highly resistant against all antibiotics except meropenem (100%) and imipenem (33.3%). Serratia marcescens was highly resistant against all antibiotics except moxifloacin (100%) and imipenem (33.3%) [Table 3].

Table 1: Demographic information of the patients (n=100)

Variable	No.	%
Gender		
Male	57	57.0
Female	43	43.0
Age (years)		
< 45	9	9/0
35 – 44	2	2.0
45 – 54	19	19.0
55 – 64	31	31.0
65 – 74	22	22.0
75 – 84	13	13.0
> 85	4	4.0
Outcome		
Mortality	32	32.0
Shifted out	68	68.0
Type of specimen		
+ve blood culture	21	21.0
+ve urine culture	79	79.0
Diagnosis		
Pyelonephritis	28	28.0
Urosepsis	54	54.0
Obstructive uropathy	18	18.0
Organism isolated		
E. coli	49	49.0
Klebsiella pneumonia	27	27.0
Pseudonomas aeruginosa	13	13.0
Klebsiella oxytoca	5	5.0
Proteus mirabilis	3	3.0
Serratia marcescens	3	3.0

Table No.2: Frequency of overall antibiotics sensitivity / resistance (n=100)

Antibiotics	Sensitive	Resistant
Ampicillin (N=52)	2	50
Cotrimoxazole (N=87)	6	81
Co-amoxiclave (N=84)	5	79
Ciprofloxacin (N=100)	25	75
Gentamicin (N=100)	8	92
Amikacin (N=100)	38	62
Cefotaxime (N=87)	5	82
Ceftriaxone (N=87)	4	83
Piperacillin/Tazobactum (N=100)	25	25
Cefoperzone/Sulbactum (N=100)	24	76
Imipenem (N=100)	34	66
Meropenem (N=100)	23	77
Tetracycline (N=84)	5	79
Ceftazidime (N=100)	7	93
Cefoperazone (N=100)	4	96
Levofloaxcin (N=100)	4	96
Moxifloaxacin (N=100)	27	73
Nitrofurantoin (N=94)	33	61
Colistin (N=94)	55	39
Tigecycline (N=84)	36	48

Table 3: Frequency of antibiotics (sensitivity/resistance) on the basis of organism (n = 100)

Antibiotics	E. Coli (R/S)	Klebsiella Pneuminae (R/S)	Pseudomonas Aeruginosa (R/S)	Klebsiella Oxytoca (R/S)	Proteus Mirabillis (R/S)	Serratia marcescens (R/S)	P value
Ampicillin	47/02	-	-	-	03/0	-	0.253
Cotrimoxazole	45/04	25/02	-	05/0	03/0	03/0	0.967
Co-amoxiclave	47/02	24/03	-	05/0	03/0	-	0.612
Ciprofloxacin	36/13	18/09	12/01	02/03	02/01	03/0	0.225
Gentamicin	46/03	23/04	13/0	05/0	02/01	03/0	0.271
Amikacin	34/15	14/13	09/04	0/05	02/01	03/0	0.027
Cefotaxime	45/04	27/0	-	05/0	02/01	03/0	0.197
Ceftriaxone	47/02	26/01	-	05/0	02/01	03/0	0.591
Piperacillin/Tazobactum	36/13	20/07	11/02	03/02	03/0	02/01	0.788
Cefoperzone/Sulbactum	35/14	20/07	11/02	04/01	03/0	03/0	0.681
Imipenem	32/17	15/12	11/02	04/01	02/01	02/01	0.583
Meropenem	38/11	19/08	12/01	05/0	0/03	03/0	0.011
Tetracycline	46/03	25/02	-	04/01	-	03/0	0.744
Ceftazidime	45/04	25/02	12/01	05/0	03/0	03/0	0.967
Cefoperazone	47/02	25/02	13/0	05/0	03/0	03/0	0.874
Levofloaxcin	47/02	26/01	12/01	05/0	03/0	03/0	0.968
Moxifloaxacin	39/10	18/09	08/05	05/0	03/0	0/03	0.019
Nitrofurantoin	29/20	25/02	06/07	01/04	-	-	0.003
Colistin	19/30	11/16	05/08	04/01	-	-	0.365
Tigecycline	27/22	16/11	-	03/02	-	02/01	0.537

DISCUSSION

Forty nine patients had infection due to E. coli, 27 due to Klebsiella pneumoniae, 13 secondary to pseudomonas aeuriginosa, 5 were Klebsiella oxytoca positive, 3 due to proteus mirabillis and remaining 3 were serratia marcescens positive respectively. A cross-sectional study was conducted was in Shifa international hospital, Pakistan from 2015 to 2016; 802 patients were admitted in ICU. Bacterial isolates results showed that 15.5% patients were positive for Acinetobacter, 15.3% for E. coli, 13% for Pseudomonas aeruginosa and 10% for Klebsiella pnemoniae.[14] Similar prevalence of bacterial isolates was noted in another study by Al Jawady et al.[15] Rajan et al[16] showed Klebsiella was most common organism isolated from patients. Ziab, et al[17] reported Pseudomonas aeruginosa isolate most prevalent organism in ICU patients. Retrospective analysis of bacterial pathogens and antimicrobial susceptibility was conducted by Mulugeta.[18] Out of 1,404 isolates, Escherichia coli was most common isolate (63.6%) followed by Klebsiella (11%) & Proteus (8%).

In another study conducted on antenatal 1197 patients, showed that E. coli was most common organism isolated (38.3%). Other organism isolated included *Klebsiella pneumoniae, Proteus mirabilis and Bacteriodes.*[19] Study conducted in Egypt included 186 clinical specimens. Most common isolated Gram-negative species was *Klebsiella pneumoniae* (40.9%), followed by *Acinetobacter baumannii* (18.8%), *Pseudomonas aeruginosa* (17.3%), *Escherichia coli* (15.4%), *Enterobacter aerogenes* (5.3%), and *Proteus mirabilis* (2.4%).[20]

In our study E. coli was highly resistant against ampicillin, cotrimazole, co-amoxiclave, gentamicin, cefotaxime and ceftriaxone. However improved sensitivity was recorded for amikacin (37.5%), ciprofloxacin (26.5%), piperacillin-tazobactam (26.5%), cefoperazone-sulbactum (28.5%), imipenem (34.6%) and meropenem (22.4%), moxifloaxacin (20.4%), colistin (61.2%), nitrofurantoin (40.8%) and tigecycline (44.9%). Drapkin, et al[21] reported that E. coli was most common isolated organism. Mostly senstive to nitrofurantoin (99%), Ciprofloxacin (84%) and Levofloxacin (85%). In another study, from 2008 till 2017; UTI associated gram negative isolates results showed E. coli to be most prevalent organism. More than 30,000 samples both from outpatient and inpatient department were included, E. coli showed resistance to ciprofloaxcin and gentamicin, however it was sensitive to fosfomycin and nitrofurantoin. Klebsiella isolates were resistant to third generation cephalosporins and gentamycin.[22]

Anyadoh et al[23] observed the sensitivity patterns in urinary tract infection patients showed that nitrofurantoin was highly effective in treating such patient showing high level of sensitivity in India, however amoxicillin and tetracycline showed low efficacy (<40%) for provided specimen. Ciprofloaxacin was effective antibiotic. However multi drug resistance was observed in 557% patients. A study was conducted by Amatya et al[24] in 2015 recording Imipenem to be 87.9% sensitive and Amikacin to be 64.6% sensitive to organism isolated from urine specimens.

In our study; Klebsiella Pneuminae was highly resistant against cotrimazole co-amoxiclave, ciprofloxacin, gentamicin cefotaxime and ceftriaxone, piperacillin/tazobactam and cefoperazone-sulbactam. However; improve sensitivity was recorded for amikacin (48.1%), moxifloaxacin (33.3%), imipenem (44.4%) and meropenem (29.6%). In 2013 study conducted in India by Chowdhury et al[25] reported Klebsiella to be most prevalent organism in urine specimen. Sensitivity results showed Imipenem to be highly sensitive (100%) and other drugs like Ceftriaxone, Gentamicin and Ceftazidime to be highly resistant against the organism.

Another study done in Nepal in 2014 reported that imipenem was effective in 96.4% cases, amikacin in 86.6% cases and piperacillin/Tazobactam in 70.7% cases.[26] In 2014, Rao et al[27] reported imipenem, amikacin and piperacillin/tazobactam sensitivity level to be >80%, while ampicillin was resistant in 53.3% cases, ceftriaxone in 73.3% cases and ciprofloaxacin similarly in 73.3% cases. E. coli was highly resistant to ampicillin (>90%), Ciprofloxacin (>90%), Cefotaxime (>80%), Ceftriaxone (>80%) and Cotrimoxazole (>70%). High sensitivity was reported for Amikacin (100% sensitive) and Gentamicin (54.5% sensitive). Li et al[28] showed that gram negative organisms were resistant to meropenem in 54.9% cases.

In our study; Pseudomonas aeruginosa was highly resistant against all antibiotics except moxifloaxacin (38.4%), colistin (61.5%) and nitrofurantoin (53.8%). Rakhee et al[29] conducteed a study on Pseudomonas aeuriginosa sensitivity, showed that Pseudomonas was highly sensitive to carbepenem (87.1%) whereas highly resistant to third generation cephalosporins (53%), cefoperazone/sulbactam (39%), 48% gentamicin and 41% amikacin in the study. In her study high carbapenem resistance i.e. 56% to meropenem and 55% to imipenem was reported. However; Sheth, et al[30] conducted a study on Klebsiella spp. 100% sensitivity to Carbapenems was recorded among patients.

Qadeer et al[15] reported that Acinetobacter was highly sensitive to colistin (3% resistance). E. coli also was highly sensitive to colistin (100%), tigecycline (100%), amikacin (93%), and carbapenems (90%). Pseudomonas aeruginosa results also showed high sensitivity to colistin (93%). For Klebsiella pneumoniae, tigecycline was 100% effective and minocycline was 84% sensitive.

CONCLUSION

High levels of antibiotic resistance are seen among all gram negative bacterial isolates. Presence of elevated resistance to multiple drugs is an indicator for high prevalence of multi-drug resistant organisms, so proper identification of organism in order to ascertain administration of emperical drugs most effective against the isolated organism is recommended in severe cases.

Author's Contribution:

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