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Antibiotic Susceptibility Pattern of Pyogenic Infectious Diseases in a Teaching Hospital of Tripura

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Abstract: India has one of the highest burdens of bacterial diseases in the world and thus, antibiotics have a significant role in reducing mortality and morbidity in the country. Area specific studies are required in monitoring the trend of type of pathogens and their sensitivity pattern in systemic infection. This study gives an account of isolation of bacterial pathogens from various clinical specimens and their antibiogram, in this geographical area of North East India. Various clinical samples like urine, sputum, body fluids, pus and blood sent to Microbiology laboratory were processed for isolation of the organisms and subsequent antibiotic susceptibility test. A total of 154 patients participated in the study, of which 113(73.4%) samples were culture positive. Female patients were significantly higher than males. The mean age has been calculated to be 55.2 years with standard deviation of 18.46. The culture proven cases of urinary tract infection were 69 (61.1%), followed by lower respiratory tract infection to be 49 (43.4%). The highest number of isolate was E. coli (26%) followed by Klebsiella pneumoniae (18.2%). There were 88(77.9%) numbers of isolates of Gram negative bacilli. The sensitivity pattern of antibiotics to Gram negative bacilli shows that, most of the isolates were sensitive to Imipenem (93 %) followed by Piperacillin Tazobactum (85.1%), Amikacin (80.5%) and Meropenem (80.5%). There were 25 isolates representing Gram positive cocci, of which Staphylococcus aureus was the predominant isolate followed by Enterococcus faecalise. The antibiotics which were observed to be more sensitive to the isolates were Vancomycin (96%), Linezolid (88%), Gentamicin (88%) and Cotrimoxazole (76%). Multiple drug resistance has been observed in 19 (16.8%) isolates. The present data represents the effective first line antibiotic agents to be Amikacin and Cefoperazone sulbactum in this geographical area.
Keywords: Clinical specimen, Bacterial isolates, Antibiotic susceptibility.

INTRODUCTION

The emergence of resistance to antimicrobial in previously susceptible bacterial pathogens is a major challenge to infectious diseases in medicine [1]. During the last decade, an increase in the rates of antimicrobial resistance has been recognized worldwide and an increased frequency of Multiple Drug Resistant isolates in the clinical setting has been demonstrated [2].

Antibiotic resistance of bacteria is a significant threat all over the world. But for developing countries like India this is an even greater public health problem. This is because India has one of the highest burdens of bacterial diseases in the world and thus, antibiotics have a significant role in reducing mortality and morbidity in the country.

Tertiary Care Hospitals have become prime source and are conducive for the development and spread of antibiotic drug resistance [3]. Irrational antibiotic usage is a potential risk factor for increased worldwide emergence of acquired resistance. Evolution of drug resistant mystery bugs had resulted in paramount cost burden, increased duration of stay, discontinuation of job, poor family economy, increase in morbidity and mortality by enlarge poses a huge menace to the community [4]. Judicious and rational optimized use of antibiotics by health care physicians is warranted to counteract this adverse situation. Area specific studies are required in monitoring the trend of type of pathogens and their sensitivity pattern for any other systemic infection. Even in areas where a few studies have been done, there is need to continue to monitor the trend in terms of the etiology and antibiotic resistance patterns.

This study has been undertaken with the objective to analyze the pattern of antibiotic

susceptibility to various isolates from clinical specimen in order to support in the formulation of antibiotic policy of the hospital.

METHODOLOGY

The study has been conducted for duration of one year from January 2016 to December 2016, at Dr. BR Ambedkar Memorial Teaching Hospital, a tertiary care referral institution of the state of Tripura, a North Eastern State of India. Relevant clinical samples of patients admitted in Medicine ward, suspected to have an infectious disease were sent to Microbiology laboratory for Culture and antibiotic susceptibility test. Informed consent has been recorded from all the study subjects in prescribed proforma as approved by Institutional Human Ethics Committee. In Microbiology laboratory, samples were inoculated in appropriate culture media. On finding significant growth of bacteria on incubation, identification of the organism was attempted by gram stain, motility test, biochemical and serological tests as and where applicable. The Antibiotic susceptibility test was performed on identified bacterial pathogen by Kirby Bauer Disc diffusion method conforming to the standard guidelines given by CLSI[5].

A pre-designed patient proforma has been filled up for each participating patient, which included patient particulars, history of illness, findings of clinical examination followed by correlation with laboratory data. Those samples which yielded no growth on culture were excluded from the study.

RESULTS

A total of 154 patients participated in the study, of which 113 samples were culture positive. Female patients were significantly higher than males. The mean age has been calculated to be 55.2 years with standard deviation of 18.46. Maximum number of patients belonged to age group of 46 to 60 years, as shown in Table No.1.

Table-1: Proportions of Age groups of patients in reference to Sex

Age group (years)	Number of Male Patients	Number of Female Patients	Total Number	Proportion (%)
16 – 30	5	13	18	11.7
31 – 45	3	24	27	17.5
46 – 60	10	37	47	30.5
61 – 75	23	21	44	28.6
76 – 90	7	9	16	10.4
>90	2	0	2	1.3
TOTAL	50	104	154	NA

Urine (55.8 %) followed by sputum (37.6 %) were the majority of samples processed for Culture and Sensitivity test. The culture proven cases of urinary tract infection were 69 (61.1%), followed by lower respiratory tract infection to be 49 (43.4%). The highest number of isolate was E. coli (26%) followed by Klebsiella pneumoniae (18.2%). Both the pathogens have been isolated in maximum numbers from urine. In sputum, the maximum number of isolate was Klebsiella pneumoniae. This observation is in reference to Table No.2 as illustrated below.

Table-2: Proportion of Isolates in reference to clinical specimen

Culture isolates	Clinical specimen (N%)							
	Blood (3)	ET Suction (1)	Pleural Fluid (1)	Pus (4)	Sputum (58)	Throat Swab (1)	Urine (86)	Total (154)
E. coli					6		34	40 (26.0)
Klebsiella pneumoniae	1	1			12		14	28 (18.2)
Pseudomonas aeruginosa	1		1		10		4	16 (10.4)
Staphylococcus aureus				3	5		6	14 (9.1)
Enterococcus faecalis					1		7	8 (5.2)
Candida albicans					10		0	10 (6.5)
Streptococcus pneumoniae					2	1		3 (1.9)
Proteus mirabilis							2	2 (1.3)
Acinetobacter sp.					1		1	2 (1.3)
Aspergillus sp.					2			2 (1.3)
Citrobacter sp.							1	1(0.6)
No growth	1			1	9		17	28 (18.2)

There were 88(77.9%) numbers of isolates of Gram negative bacilli, which included E. coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus mirabilis, Citrobacter sp. and Acinetobacter sp. The sensitivity pattern of antibiotics to Gram negative bacilli shows that, most of the isolates were sensitive to Imipenem (93 %) followed by Piperacillin Tazobactum (85.1%), Amikacin (80.5%) and Meropenem (80.5%). The observation has been depicted in Table No. 3.

Table-3: Antibiotic susceptibility pattern of Gram negative isolates

Isolate (N=88)	IPM	MRP	PIT	CFS	CZ	CXM	CTR	CPM	AK	CIP	LEV	COT
E.coli (n=40)	39	35	36	36	8	22	28	28	36	14	18	31
K.pneumoniae (n=28)	26	22	23	22	6	15	19	19	22	11	15	20
P.aeruginosa (n=16)	13	11	12	10	0	0	0	10	10	8	8	3
Proteus mirabilis(n=2)	2	1	2	2	0	0	1	1	2	1	1	1
Acinetobacter spp (n=2)	2	1	2	1	0	0	1	1	1	1	1	1
Citrobacter spp (n=1)	1	1	1	1	0	0	0	0	1	0	1	0
TOTAL	83 (94.3 %)	71 (80.7 %)	76 (86.4 %)	72 (81.8 %)	14 (15.9 %)	37 (42%)	49 (55.7 %)	59 (67%)	72 (81.8 %)	35 (39.8 %)	44 (50%)	56 (63.6 %)

IPM – Imipenem; MRP – Meropenem; PIT – Piperacillin Tazobactum; CFS – Cefoperazone Sulbactum ; CZ – Cefazolin; CXM – Cefuroxime; CTR – Ceftriaxone; CPM – Cefipime; Ak – Amikacin; CIP – Ciprofloxacin; LEV – Levofloxacin; COT - Cotrimoxazole.

There were 25 isolates representing Gram positive cocci, of which Staphylococcus aureus was the predominant isolate followed by Enterococcus faecalis and Streptococcus pneumoniae. The antibiotics which were observed to be more sensitive to the isolates were Vancomycin (96%), Linezolid (88%), Gentamicin (88%) and Cotrimoxazole (76%). The observation has been depicted in Table No. 4.

Table-4: Antibiotic susceptibility pattern of Gram positive isolates

Isolate (n=25)	VA	LZ	COT	AMC	CIP	LEV	GEN	CZ	CXM
S.aureus (n=14)	14	12	10	2	8	10	12	7	9
Enterococcus Spp.(n=8)	7	7	6	1	4	5	7	3	3
Streptococcus pneumoniae (n=3)	3	3	3	2	2	2	3	2	3
TOTAL	24 (96%)	22 (88%)	19 (76%)	5 (20%)	14 (56%)	17 (68%)	22 (88%)	12 (48%)	15 (60%)

VA – Vancomycin; LZ – Linezolid; COT – Cotrimoxazole; AMC – Amoxycillin Clavulanic acid ; CIP – Ciprofloxacin; LEV – Levofloxacin; G – Gentamicin; CZ – Cefazolin; CXM – Cefuroxime.

Multiple drug resistance has been observed in 19 (16.8%) isolates out of 113 culture positive cases. Those isolated organisms which exhibited resistance to at least three classes of antibiotics were considered to be Multi-Drug Resistant.

DISCUSSION

A total of 154 patients participated in the study, of which 113 (73.4%) samples were culture positive. The culture positivity varies with geographical location, methodology and clinical criteria for selection of study participants. In a study from Karachi, the positivity rate was stated to be as high as 87.17% whereas another study from Singapore reported a culture positivity rate of 56.4% respectively [6,7]. However, a negative culture does not completely rule out the possibility of infection in a patient.

It is a documented fact that infectious diseases are more common in females compared to males. Apart from cultural and behavioral differences that play an important role in exposure to pathogens, biological and immunological pathways affected by sex hormones and consequences of differential expression of X-

chromosome encoded genes on immune responses to pathogens are important factors resulting in sex differences in infectious diseases [8]. In the present study the female participants (67.53%) were more than males. This observation is comparable to the reports from other studies stating 62.42% from Rajasthan and 60.2% from Odisha[9,10].

The older persons usually have greater susceptibility to infection, which is associated with immune dysfunction of especially cell mediated immunity and variety of chronic disorders that affect the integrity of host resistance[11]. In the present study, maximum number of patients belonged to age group of 46 to 60 years (30.5%) followed by 61 to 75 years (28.6%), having mean age of 55.2 ± 18.46 year. A study from Eastern India reported average age of participants to be 48.2± 17.5 year[12].

Urinary tract infections (UTIs) are the most common bacterial infection encountered in tertiary care settings [13]. In the present study, culture positive cases of Urinary tract infection (61.1%) were most common followed by Lower respiratory tract infection (43.4%).

There were 77.9% of isolates as Gram negative bacilli. The highest number of isolate was E. coli (26%) followed by Klebsiella pneumoniae (18.2%). Both the pathogens have been isolated in maximum numbers from urine. In sputum, the maximum number of isolate was Klebsiella pneumoniae. A similar study from Eastern India reported 61.3% isolates as gram negative, in which 63% were E.coli and 22.8% were Klebsiella pneumoniae [13].

There were 22.1% isolates representing Gram positive cocci. Staphylococcus aureus (14) was the predominant isolate followed by Enterococcus faecalis and Streptococcus pneumoniae. A similar study from Kolkata reported 38.7% gram positive organisms with Staphylococcus aureus isolated in 16 patients followed by Enterococcus faecalis [13].

In our study, gram negative bacilli shows maximum sensitivity to Imipenem (94.3 %) followed by Piperacillin Tazobactum (86.4%), Cefoperazone Sulbactum (81.8%), Amikacin (81.8%) and Meropenem (80.7%). Whereas the antibiotics which were observed to be more sensitive in the gram positive isolates were Vancomycin (96%), Linezolid (88%), Gentamicin (88%) and Cotrimoxazole (76%). A study from Bangladesh, which is adjacent to this region, reported high proportions of sensitivity to Imipenem, Meropenem, Gentamicin and Amikacin and significant resistance to Amoxycillin, Cephalosporins, Cotrimoxazole and Fluoroquinolones [14]. Another study from North India reported high susceptibility of Gram negative bacteria to Amikacin, Cefoperazone sulbactum, Piperacillin-tazobactum, Ceftriaxone-sulbactum and Gentamicin. In the same study, Gram positive organism exhibited high susceptibility to Vancomycin, high content Gentamicin, and Streptomycin [15]. A study from Eastern India stated that Vancomycin and Linezolid resistance were very rare in Gram positive organisms. For E. coli and Klebsiella, resistance to 3rd and 4th generation cephalosporins varied from 64 to 94%. Cotrimoxazole resistance varied from 75—100% for different species [13].

The Beta-lactam and Beta-lactamases inhibitor combinations were found significantly effective in the present study. Isolates susceptible to Piperacillin tazobactum and Cefoperazone-sulbactum were 86.4% and 81.8% respectively. Resistance may develop to Beta-lactamases inhibitor due to production of inhibitor resistance. TEMβ-Lactamase. The isolates in the present study showed low level of susceptibility to Cephalosporins. The decreased susceptibility of Cephalosporins could be due to production of Extended Spectrum Beta Lactamases and AmpC Beta-lactamases.

Among the fluoroquinolones tested, the Gram positive isolates showed better sensitivity to Levofloxacin (68%), compared to Ciprofloxacin. High resistance to Ciprofloxacin has been reported in other studies stating 63% to as high as 76.9% strains to be resistant [16, 17].

In our study, multiple drug resistance has been observed in 19 (16.8%) isolates out of 113 culture positive cases. A study from Karachi, reported a total of 90 (20.59%) multi-drug resistant organisms isolated among 437 culture positive cases [6].

We observed that sensitivity pattern in different studies show different proportion. It indicates variation of susceptibility of antibiotics with geographical area. It may be due to local practice of antibiotic use and abuse of over the counter drug. This wide variation of antibiotic susceptibility further signifies necessity of implementation of institutional antibiotic policy.

IDSA guideline recommends a bench mark of about 10-20% resistance at which first line empirical therapy should be modified [18]. In the present study, the antibiotics that can be considered as first line therapy are a Beta-lactamases inhibitor like Cefoperazone sulbactum and aminoglycoside like Amikacin, especially for Beta-Lactamase producers in Gram negative isolates. In case of Gram positive isolates, Gentamicin and Cotrimoxazole can be considered for treatment as first line antibiotics. The antibiotics like Imipenem, Vancomycin, Linezolid and Piperacillin-tazobactum should be kept reserved and only administered in situations which warrants their use depending on the antibiotic susceptibility pattern of the isolate. This will prevent the irrational use of antibiotics

and reduce the antibiotic pressure on the strains in this geographical area.

CONCLUSION

Enterobacteriacae group of bacteria including Escherichia coli and Klebsiella pneumoniae can be stated as the major cause of different types of infections in this region. As the infections were diagnosed in hospitalized patients, it indicates that these organisms can be potent nosocomial pathogens in our hospital. The present data represents the effective first line antibiotic agents to be Amikacin and Cefoperazone sulbactum. As variation in scenario of antibiotic susceptibility pattern exists from time to time and in different geographical areas, more studies need to be conducted at intervals, based on which hospital policies are to be modified.

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