Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: www.saspublishers.com

OPEN ACCESS

Microbiology

Antibiotic Sensitivity Pattern of Pathogenic Bacteria: A Study in a Tertiary Care Hospital, Rajshahi, Bangladesh

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DOI: 10.36347/sjams.2019.v07i07.047 | **Received:** 02.07.2019 | **Accepted:** 09.07.2019 | **Published:** 30.07.2019

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Abstract **Original Research Article**

Introduction: Besides non-infectious diseases and disorders, infectious diseases still remain a major cause of morbidity and mortality in third-world countries including Bangladesh. Bacterial pathogens resistant commonly used antimicrobials are now creating a challenge to the clinicians and researchers. ***Methods:*** It was a prospective study carried out during the period from January 2014 to October 2014 in Rajshahi Medical College Hospital, Bangladesh. Samples were collected from both sexes and different age groups admitted in the mentioned hospital. The clinical isolates were tested and the included specimens were Urine, Pus, Sputum, Vaginal swab, Throat swab and Conjunctival swab. ***Result:*** In this study the selected antibiotics were Imipenem and it was 97.32%. Then Ceftriaxone 90.64%, Cefixim 89.76%, Cefuroxim 90.85%, Ofloxacin 87.82%, Cephradin 85.76, Amoxyclav 86.27, Ceftazidim 83.14%, Levofloxacin 83.13%, Nitrofurantoin 82.50%, Azithromycin 82.10%, Fusidic Acid 80.04%, Vancomycin 79.23%, Ciprofloxacin 77.04%, Mecillinam 74.18%, Cotrimoxazole 74.40%, Gentamycin 73.72 and Amikacin 72.81%. On the other hand, the main pathogenic bacteria we found were Escherichia coli, Klebsiella species, Staphylococus aureus, Pseudomonas species, Provindencia species and some other species with little effect. Out of total organisms isolated, majority were Escherichia coli & Klebsiella species. On the other hand, among 18 antimicrobials we found Imipenem as the most effective against the pathogens. ***Conclusion:*** Day by day multi drug resistance patients are increasing. In our study we also found some broad spectrum antibiotics less effective in some cases which is very alarming. We would like to recommend for conducting more and multi-centered study to collect more and specific information about common and notorious pathogenic bacteria and antibiotics against them.

Key words: Antibiotic Sensitivity, Resistance, Pathogenic Bacteria.

INTRODUCTION

This was a prospective study and it was conducted during the period from January 2014 to October 2014 in a tertiary care hospital in Bangladesh. The main objective was to assess the pattern of pathogenic bacteria and their antibiotic sensitivity profile in the treatment procedure of several infectious diseases. The samples were collected from both sexes and different age groups admitted in the mentioned hospital. A total of 460 bacteria strains were isolated from various specimens and those were the total study objects. It is said that, evolution of bacteria towards resistance to antimicrobial drugs, including multidrug resistance, is unavoidable because it represents a particular aspect of the general evolution of bacteria that is un-stoppable [2]. Infectious diseases still remain a major cause of morbidity and mortality in third-world countries including Bangladesh. Bacterial pathogens resistant commonly used antimicrobials are now creating a challenge to the clinicians and researchers. The multi-drug-resistant organisms are a serious medical problem that has significantly affected the treatment of infectious diseases [3,4] and has become a major clinical concern globally [5, 6]. Bacterial resistance pattern to antimicrobial agents can differ significantly from one country to another and within a country as evidenced by several recent surveillance studies [7-10]. Introduction of newer antimicrobial agents is usually followed sooner or later by emergence of bacterial resistance of these drugs for many reasons [11]. Development of multi-drug resistance in clinical isolates like Salmonella typhi, Pseudomonas species and Klebsiella species has been reported in Bangladesh [12-14]. The study on antibiotic susceptibility pattern is particularly important is developing countries that do

not control antibiotic usage and maintain adequate epidemiological surveillance. Therefore, the present study has been designed to find out the antibiotic resistance patterns of medically important bacteria in an urban hospital. The outcome of this study might enable to determine the trend of drug resistance prevailing in Bangladesh. There may remain many causes for increasing antibiotic resistance in Bangladesh but in treating patients we found a lot of cases of sub therapeutic dosage intake of patients in this community which may be a major cause of drug resistance.

OBJECTIVES

General Objective

To assess the pattern of pathogenic bacteria and their antibiotic sensitivity profile in Bangladesh.

Specific Objective

To know more about bacterial resistance and the efficacy of some traditional antibiotics

METHODS & MATERIALS

This was a prospective study carried out in Rajshahi Medical College Hospital (RMCH), Rajshahi, Bangladesh. Samples were collected over a ten months period during January 2014 to October, 2014 from both sexes and different age groups. In total 460 respondents with clinically positive infectious cases were the study populations for those respondents' clinical isolates were tested and the included specimens were Urine, Pus, Sputum, Vaginal swab, Throat swab and Conjunctival swab. All samples were routinely cultured on Nutrient agar MacConkey and Blood agar plates. In addition to these plates, Chocolate agar media were used for culturing Pus, Vaginal swab and Conjunctival swab specimens. After overnight incubation, plates were checked for the presence of suspected pathogens. All the suspected colonies were identified by colony characteristics, motility, Gram staining results, and biochemical reactions [15]. Antimicrobial susceptibility test of the isolated organisms was done by disk diffusion method using the Kirby-Bauer technique [16] and as per recommendations of the National Committee for Clinical Laborratory Standards [6]. Antimicrobial agents used for determining antibiogram of isolated organisms were Amikacin (AMK), Amoxyclav (AMC), Azithromycin (AZM), Cefixim (CFM), Ceftazidim (CZM), Ceftriaxone (CXN), Cefuroxim (CXM), Ciprofloxacin (CIP), Cotrimoxazole (COT), Gentamycin (GNT), Mecillinam (MLM) Vancomycin (VAN), Fusidic Acid (FUA), Levofloxacin (LEV), Cephradin (CDN), Nitrofurantoin (NFN), Imipenem (IMP) and Ofloxacin (OFL). All disks for diagnosis were obtained from Oxoid Ltd, Basinstoke, Hampsire, UK. In order to monitor the quality of the test result, on each day of testing the reference ATCC stains Escherichia coli ATCC 25922 and staphylococcus aureus ATCC 292213 were included. The zone of inhibition was compared with recommended standard values [17]. It was a single centered study and both single and multi-bacterial infected patients were included as the study population.

RESULT

A Total of 460 strains of bacteria were isolated from various specimens. The specimens wee Urine, Sputum, Pus, Throat swab and others including Vaginal and Conjunctival swabs. Out of total organisms isolated, majority were Escherichia coli 146 (31.74%) followed by Klebsiella species 112 (24.35%), Staphylococus aureus 76 (16.52%), Pseudomonas species 52 (11.30%) Proteus species 27 (5.87%), Streptococcus 19 (4.13%), Salmonella 15 (3.26%) and Citobacter 13/2.83% (Figure I &Table I). On the other hand, the most effective antibiotic we found Imipenem. Susceptibility of Imipenem was 97.32%. Then Ceftriaxone 90.64%, Cefixim 89.76%, Cefuroxim 90.85%, Ofloxacin 87.82%, Cephradin 85.76, Amoxyclav 86.27, Ceftazidim 83.14%, Levofloxacin 83.13%, Nitrofurantoin 82.50%, Azithromycin 82.10%, Fusidic Acid 80.04%, Vancomycin 79.23%, Ciprofloxacin 77.04%, Mecillinam 74.18%, Cotrimoxazole 74.40%, Gentamycin 73.72 and Amikacin 72.81%. So in this study we found Imipenem as the most effective antibiotic which showed susceptibility up to 97, 32% and less sensitive antibiotic was Amikacin which showed susceptibility up to 72.81%. About resistance, in this study we found Amikacin with most resistant to highest number of pathogenic bacteria. That ratio was 27.19% and it followed by GNT 26.28%, COT 25.60%, MLN 25.82, CIP 22.96%, VAN 20.77%, FUA 19.96%, AZM 17.90%, NFN 17.49%, LEV 16.87%, CZM 16.86%, AMC 13.73%, CDN 14.24%, OFL 12.17%, CXM 9.51% and IMP 2.68%. So in this study we found Imipenem as the most effective antibiotic which showed the best efficacy against both grams positive as well as gram negative bacteria. We also found cephalosporin derivatives more effective than macrolides fluoroquinolone derivatives.

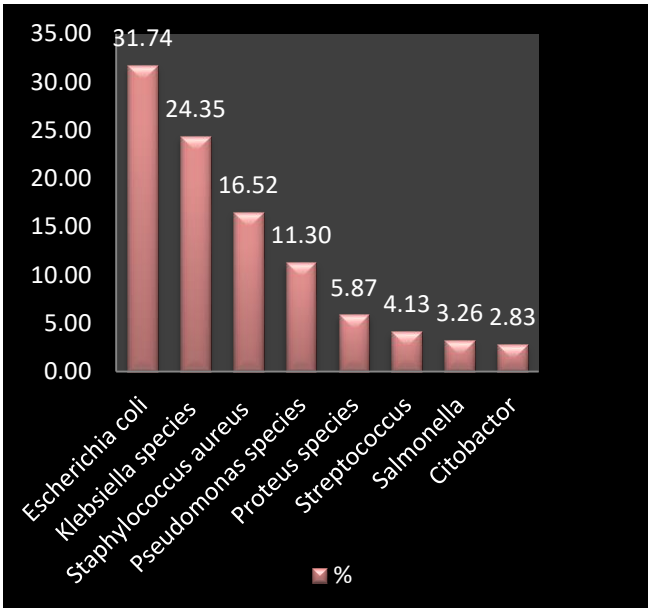

Fig-I: Ratio of pathogenic bacteria isolation (n=460)

Table-1: Pattern of organism isolated from various samples (n=460)

Name of organisms	Number	Percentage
Escherichia coli	146	31.74
Klebsiella species	112	24.35
Staphylococcus aureus	76	16.52
Pseudomonas species	52	11.30
Proteus species	27	5.87
Streptococcus	19	4.13
Salmonella	15	3.26
Citobactor	13	2.83
Total	460	100

Table-II: Sensitivity of the antibiotics against isolated bacteria (n=460)

Bacteria/Antiiotic	E.coli		Kleb.		Steph.		Pseudomonas		Proteus		Strep.		Salmo.		Citobacter	
	(n=146)		(n=112)		(n=76)		(n=52)		(n=27)		(n=19)		(n=15)		(n=13)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
AMK	97	66.44	78	69.64	59	77.63	38	73.08	19	70.37	13	68.42	12	80.00	10	76.92
AMC	117	80.14	94	83.93	70	92.11	47	90.38	22	81.48	16	84.21	14	93.33	11	84.62
AZM	116	79.45	91	81.25	66	86.84	45	86.54	21	77.78	14	73.68	13	86.67	11	84.62
CFM	137	93.84	101	90.18	70	92.11	48	92.31	24	88.89	17	89.47	13	86.67	11	84.62
CZM	122	83.56	92	82.14	68	89.47	41	78.85	19	70.37	17	89.47	13	86.67	11	84.62
CXN	127	86.99	104	92.86	72	94.74	49	94.23	24	88.89	17	89.47	14	93.33	11	84.62
CXM	121	82.88	93	83.04	73	96.05	49	94.23	25	92.59	17	89.47	14	93.33	12	92.31
CIP	108	73.97	83	74.11	58	76.32	39	75.00	18	66.67	15	78.95	13	86.67	11	84.62
COT	78	53.42	92	82.14	52	68.42	36	69.23	19	70.37	14	73.68	14	93.33	11	84.62
GNT	84	57.53	92	82.14	49	64.47	35	67.31	18	66.67	14	73.68	14	93.33	11	84.62
MLN	93	63.70	71	63.39	53	69.74	38	73.08	18	66.67	15	78.95	14	93.33	11	84.62
VAN	119	81.51	92	82.14	53	69.74	36	69.23	18	66.67	15	78.95	14	93.33	12	92.31
FUA	107	73.29	84	75.00	70	92.11	44	84.62	19	70.37	14	73.68	13	86.67	11	84.62
LEV	96	65.75	79	70.54	71	93.42	49	94.23	20	74.07	18	94.74	12	80.00	12	92.31
CDN	89	60.96	99	88.39	71	93.42	47	90.38	21	77.78	17	89.47	14	93.33	12	92.31
NFN	88	60.27	100	89.29	66	86.84	45	86.54	21	77.78	14	73.68	14	93.33	12	92.31
IMP	144	98.63	111	99.11	74	97.37	50	96.15	25	92.59	18	94.74	15	100.00	13	100.00
OFL	128	87.67	95	84.82	71	93.42	48	92.31	24	88.89	16	84.21	13	86.67	11	84.62

Amikacin=AMK, Amoxyclav=AMC, Azithromycin=AZM, Cefixim=CFM, Ceftazidim=CZM, Ceftriaxone=CXN, Cefuroxim=CXM, Ciprofloxacin=CIP, Cotrimoxazole=COT, Gentamycin=GNT, Mecillinam MLM, Vancomycin=VAN, Fusidic Acid=FUA, Levofloxacin=LEV, Cephradin=CDN, Nitrofurantoin=NFN, Imipenem=IMP and Ofloxacin=OFL.

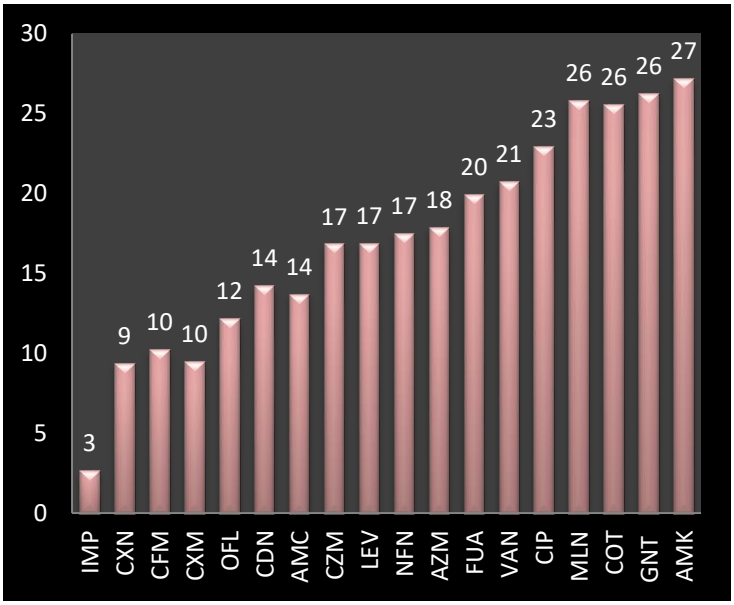

Fig-II: Average resistance percentages of antibiotics (n=460)

DISCUSSION

In Bangladesh there are traditions of taking medicine in sub therapeutic dosages. Malpractice is a common picture here. Antibiotic resistance is a common phenomenon in developing countries where drugs are available freely without prescription. Now-a-days, antibiotics have been extensively and newer antibiotics are continuously being added for the treatment of various infections. Proper use of antibiotics is very important in reducing unnecessary expenses, development of resistance to useful and life-saving antibiotics as well as to minimize many side effects. The resistance pattern varies from one country to another. In the present study, most of the bacteria were sensitive to Imipenem ranging more 97%. This high level of sensitivity to Imipenem could be due to its restricted and limited use in the clinical practice and the higher price of Imipenem dosage. The drug has only recently been introduced in Bangladesh and is very expensive which has further restricted its widespread use. Similar effectiveness of Imipenem has also been reported from other countries [18, 19]. The third-generation cephalosporins like Ceftriaxone, Ceftazidime and Cefotaxime were sensitive against 56-66% isolated Enterobacteriaceas. The first-and second-generation Cephalosporins were less effective. In the United States, the frequency of resistance to Ceftazidime has increased from 1.5% to 3.6% from 1991 to 1997 as reported by the National Nosocomial Infections Surveillance system. A surveillance trial involving 102 medical centres in the United States detected 10.3% and 23.8% Ceftazidime-resistant E.coli and K. pneumoniae respectively [18]. However, the sensitivity of various Enterobacteriaceae to Ciprofloxacin in the present study was only between 33-40%. This low-level of sensitivity to Quinolones and Cephalosporins was the result of very extensive use of these antibiotics in clinical practice. A large majority of patients were found prescribed by these drugs on their first contact with physicians [18]. All the staphylococcus anreus isolated in this study were sensitive to Vancomycin whereas 70% were Methicillin resistant (MRSA). The prevalence of MRSA differs strongly between countries[17]. In the present study, very high isolation rate of MRSA was found as detected by 1 µg Oxacillin disk. Another study with wound specimens from diabetic patients in Bangladesh in 1994, reported an isolation rate of 37.2% and 21.6% MRSA amongst the hospitalized and non-hospitalized diabetics respectively [20]. The present findings show that the prevalence of MRSA in hospitalized patients has increased significantly over time. This study would help the physicians to make judicious choice of antibiotics and would be helpful for formulation of an antibiotic policy. According to the recent statement of WHO 'The world urgently needs to change the way it prescribes and uses antibiotics. Even if new medicines are developed, without behavior change, antibiotic resistance will remain a major threat. Behavior changes must also include actions to reduce the spread of infections through vaccination, hand washing, practicing safer sex, and good food hygiene [21]. So, we should be more careful about the uses of antibiotics in treatment.

Limitations of the study

This was a clinical study in a single center with a sample size. So, the study results may not reflect the scenarios of the whole community.

CONCLUSION AND RECOMMENDATIONS

Malpractice is a common picture in Bangladesh like other countries. Malpractices and taking medicine without prescriptions may the major cause of bacterial resistance in this community. So, increasing awareness and knowing more about pathogenic bacteria and their resistances against several antibiotics. We would like to recommend for more study in more places.

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