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Antibiotic susceptibility pattern of UTI and RTI isolates from a tertiary care hospital in Coimbatore, Tamil Nadu

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Abstract

Antibiotic resistance is a major world-wide problem in the intensive care unit (ICU) and General ward (GW), including in India. This study thus aims to provide the evidence of the various resistivity patterns of RTI and UTI isolates. Totally 240 isolates isolated from ICU and GW units. Most common etiological organisms of RTI and UTI isolated were *Escherichia coli* (20%), and *Klebsiella spp* (19%). Most of the bacteria recovered from RTI and UTI showed the highest degree of susceptibility from Amikacin, Imipenem, Chloramphenicol, Piperacillin+tazobactum, Astreonam, Augmentin(amox+clav), Cefotaxime, Gentamycin, Netilmycin, Tobramycin, Meropenem and Ofloxacin.

Keywords: Antibiotic resistance, ICU and GW units, RTI and UTI.

Introduction

Antimicrobial resistance has become a serious public health problem worldwide. Infections caused by resistant bacteria are associated with increased morbidity and mortality than those caused by susceptible pathogens (Asati, 2013; Travers and Barza, 2002). Infections caused by resistant bacteria led to prolonged hospital stays, increased health care costs and in many cases to untreatable infections (Byarugaba, 2004).

Antimicrobial-resistant pathogens, including methicillin resistant *Staphylococcus aureus* (MRSA) (community associated (CA-MRSA) and healthcare-associated (HA-MRSA), vancomycin-resistant *Enterococcus* species (VRE), penicillin-resistant *Streptococcus pneumoniae*, extended-spectrum b-lactamase (ESBL)-producing *Escherichia coli* and *Klebsiella* species,(2-3) and fluoroquinolone - resistant and carbapenem resistant members of the family *Enterobacteriaceae* and *Pseudomonas aeruginosa* are increasing in prevalence globally (Lockhart *et al*., 2007; Pitout *et al*., 2005).

Prevention of the emergence and dissemination of resistant microorganisms will reduce adverse events and their attendant costs. Appropriate antimicrobial stewardship that includes optimal selection, dose, and duration of treatment, as well as control of antimicrobial use, will prevent or slow the emergence of resistance among microorganisms (Shlaes *et al*., 1997). Development of AM resistance pattern is directly proportional to the volume of antimicrobial consumed. Therefore, to reduce the development of antimicrobial resistance usage regulation is essential (Sharma and Barman, 2010). Monitoring the use of antimicrobials and review of sensitivity patterns are imperative. Audit of antimicrobial

sensitivity patterns in ICUs and critical care units (CCUs) are crucial and far more important for giving effective treatment and decreasing the spread of resistance.

The present study was, therefore, designed to audit the antimicrobial sensitivity pattern of microbial isolates from patients in intensive care units (ICUs) and GW of a tertiary care hospital in Tamil Nadu, India.

Materials and Methods

Clinical samples of RTI and UTI received in microbiology laboratory were considered from ICU and GW units of the hospital. A total of 951 samples from ICU unit and GW unit suspected to be having respiratory tract infection and urinary tract infection were cultured and further analyzed. Exclusion criteria were patients already on antibiotic therapy. At 37°C for 24 hours of incubation, predominant growth (on Nutrient agar, blood agar, MacConkey s agar) of single bacteria was seen in 240 isolates. The bacterial isolates were identified and confirmed using standard microbiological method which included Gram staining, colonial morphology on media, and growth on selective media, lactose fermentation, catalase, oxidase, coagulase, indole, citrate utilization, urease tests and hanging drop preparation for motility (Collee *et al.*, 1996).

Antibiotic susceptibility testing was performed by the disc diffusion assay on Muller Hinton Agar by Kirby-Bauer method (Collee *et al.*, 1996) using the following antibiotics disc: Amikacin, ampicillin, astreonam, augmentin(amox+clav), Cefaclor, cefazolin, cefotaxime, ceftazidime, ceftriaxone, cefuroxime, cephalexin, chloramphenicol, ciprofloxacin, clindamycin, cloxacillin, co-trimoxazole, doripenem, ertrapenem, erythromycin, furozolidine, gentamycin, Imipenem, linizolid, magnex(cefaperazone+sulbactum), meropenem, nalidixic acid, netilmycin, Nitrofurantoin, norfloxacin, ofloxacin, oxacillin, penicillin, piperacillin+tazobactum, teicoplanin, Tetracycline, tobramycin and vancomycin. Interpretation of diameter of growth inhibition zone was done by using the standard interpretative chart provided by disc manufacturer. At 37°C, after 24 hours of incubation, organisms were scored as sensitive or resistant to corresponding antibiotic on the basis of zone of inhibition following the criteria of Clinical and Laboratory Standards Institute (Sumera Sabir *et al.*,2014).

Results and Discussion

The isolation pattern of organisms as well as infection pattern is given in Table 1. The most frequently isolated organisms were *E.coli* (20.8 %) and *K. pneumoniae* (19.5 %) in both sputum and urine samples of RTI and UTI patients. The *Proteus* sp, *Salmonella* sp and *Serratia* sp were obtained very minimum level of 0.5%.

Table 1. Isolation pattern of organisms and infection pattern

	Gram Negative bacteria										Gram Positive bacteria	
	KL	**EC**	**PRO**	**PSEU**	**SAL**	**EB**	**AB**	**SER**	**MOR**	**CPS**	**STREP**	**ENTERO**
TOTAL ISOLATES	47	50	1	15	1	6	18	1	2	25	6	19
ICU												
RTI	18	2	0	6	0	3	11	0	0	5	2	1
UTI	7	4	0	1	0	0	3	0	1	3	0	6
GENERAL WARDS												
RTI	11	3	0	5	0	1	3	0	0	4	4	0
UTI	11	41	1	3	0	2	1	1	1	13	0	11

Total samples received	880
Culture positives	240

Table 2. Antibiogram report – Bacteria responsible for Respiratory tract infection

		RESPIRATORY TRACT INFECTION IN ICU (Zone of inhibition in %)						RESPIRATORY TRACT INFECTION IN WARDS (Zone of inhibition in %)					
		GRAM NEGATIVE				GRAM POSITIVE		GRAM NEGATIVE				GRAM POSITIVE	
S.NO	DRUG NAME	KLEB	EC	PRO	EB	CPS	STREP	KLEB	E.C	PRO	EB	CPS	STREP
1	Penicillin	0	0	0	0	0	69	0	0	0	0	33	32
2	Ampicillin	6	50	100	0	63	85	25	0	0	0	100	68
3	Augmentin(amox+clav)	34	100	100	50	100	85	65	0	0	0	100	84
4	Cloxacillin	0	0	0	0	100	0	0	0	0	0	100	4
5	Cephalexin	12	0	100	0	75	69	13	0	0	0	100	48
6	Cefotaxime	34	50	100	25	88	100	70	50	0	0	100	80
7	Ceftazidime	34	50	0	50	88	92	75	0	0	0	100	76
8	Cefaclor	10	0	0	0	0	0	35	0	0	0	0	0
9	Ceftriaxone	22	50	0	0	0	0	65	50	0	0	0	0
10	Gentamycin	72	100	100	75	100	85	95	100	0	0	100	84
11	Netilmycin	74	100	100	100	100	85	70	100	0	0	100	84
12	Amikacin	86	50	100	100	100	77	80	100	0	0	100	76
13	Tobramycin	80	100	100	75	100	77	95	100	0	0	100	72
14	Meropenem	90	100	100	75	0	0	90	100	0	0	0	0
15	Clindamycin	0	0	0	0	38	38	0	0	0	0	33	20
16	Imipenem	100	100	100	75	0	0	100	100	0	0	0	0
17	Ciprofloxacin	80	100	0	75	100	77	90	50	0	0	100	68
18	Ofloxacin	70	100	100	75	88	0	95	50	0	0	100	4
19	Norfloxacin	0	0	0	0	0	0	5	0	0	0	0	0
20	Co-trimoxazole	38	100	100	25	50	31	60	0	0	0	67	64
21	Tetracyclin	0	0	0	0	100	69	0	0	0	0	100	60
22	Erythromycin	0	0	0	0	75	85	0	0	0	0	100	68
23	Nalidixic acid	0	0	0	0	0	0	0	0	0	0	0	0
24	Nitrofurantoin	0	0	0	0	0	0	0	0	0	0	0	0

25	Chloramphenicol	78	100	100	50	100	85	95	50	0	0	67	76
26	Vancomycin	0	0	0	0	100	69	0	50	0	0	100	60
27	Furozolidine	0	0	0	0	0	0	0	0	0	0	0	0
28	Oxacillin	0	0	100	0	100	100	0	0	0	0	0	0
29	Piperacillin+tazobactum	100	100	0	100	100	77	95	100	0	0	100	100
30	Magnex(cefaperazone+sulbactum)	28	50	0	25	88	80	70	50	0	0	100	76
31	Astreonam	32	100	100	50	0	8	75	50	0	0	0	10
32	Linizolid	0	0	0	0	100	69	0	0	0	0	100	72
33	Doripenem	0	0	0	0	0	0	0	0	0	0	0	0
34	Cefazolin	18	50	0	0	0	0	45	0	0	0	0	0
35	Ertrapenem	30	50	0	75	0	0	45	0	0	0	0	0

Where, Kleb – *Klebsiella,pneumoniae* EC – *E. coli*, Pro – *Proteus sp*, EB- *Enterobacter sp*, CPS- *Coagulase –positive Staphylococci* Strep – *Streptococcus sp*

Table 3. Antibiogram report – Bacteria responsible for Urinary tract infection

		URINARY TRACT INFECTION IN ICU (Zone of inhibition in %)						**URINARY TRACT INFECTION IN WARDS (Zone of inhibition in %)**					
		GRAM NEGATIVE				**GRAM POSITIVE**		**GRAM NEGATIVE**				**GRAM POSITIVE**	
S.NO	DRUG NAME	KLEB	EC	PRO	EB	CPS	STREP	KLEB	E.C	PRO	EB	CPS	STREP
1	Penicillin	0	0	0	0	0	0	0	0	0	50	7	18
2	Ampicillin	8	12	0	0	67	13	0	16	50	50	13	73
3	Augmentin(amox+clav)	27	47	0	50	67	38	29	76	50	50	100	91
4	Cloxacillin	0	0	0	0	100	25	0	0	0	0	93	9
5	Cephalexin	0	0	67	50	33	13	21	33	50	100	47	9
6	Cefotaxime	23	24	67	50	33	0	36	59	50	0	67	63
7	Ceftazidime	27	41	67	50	33	13	29	75	50	0	80	36
8	Cefaclor	4	11	67	50	0	0	21	29	50	0	0	0

9	Ceftriaxone	4	0	33	50	0	0	0	2	0	0	0	0
10	Gentamycin	69	82	100	50	33	50	50	96	50	50	100	64
11	Netilmycin	50	76	33	50	33	38	50	100	50	50	100	64
12	Amikacin	58	76	100	100	67	63	57	100	50	50	100	64
13	Tobramycin	50	65	100	0	33	38	64	96	50	100	100	45
14	Meropenem	92	94	100	100	0	0	79	96	100	100	0	0
15	Clindamycin	0	0	0	0	33	0	0	0	0	0	40	9
16	Imipenem	100	100	100	100	0	0	100	100	100	100	0	0
17	Ciprofloxacin	76	76	67	100	33	88	98	71	50	100	93	82
18	Ofloxacin	53	53	100	50	67	50	71	65	50	100	60	91
19	Norfloxacin	29	29	33	0	0	25	21	41	50	50	20	27
20	Co-trimoxazole	12	12	33	50	33	38	29	37	0	0	46	45
21	Tetracyclin	0	0	0	0	33	63	0	0	0	0	67	100
22	Erythromycin	0	0	0	0	0	0	0	0	0	0	67	45
23	Nalidixic acid	6	6	0	0	0	13	21	16	0	0	7	18
24	Nitrofurantoin	70	71	0	50	33	38	29	88	0	0	33	100
25	Chloramphenicol	76	76	100	50	67	100	79	94	50	50	100	100
26	Vancomycin	0	0	0	0	67	100	0	0	0	0	100	100
27	Furozolidine	0	0	0	0	67	0	0	0	0	0	100	0
28	Oxacillin	82	83	67	50	33	50	79	100	50	100	100	63
29	Piperacillin+tazobactum	34	34	67	50	67	63	36	63	50	50	93	45
30	Magnex(cefaperazone+sulbactum)	59	56	67	50	0	0	43	86	50	50	0	0
31	Astreonam	0	0	0	0	67	50	0	0	0	0	87	100
32	Linizolid	0	0	0	0	0	0	0	0	0	0	0	0
33	Doripenem	12	12	67	50	0	0	21	33	50	0	0	0
34	Cefazolin	24	24	0	0	0	0	43	45	50	50	0	0
35	Ertrapenem	12	12	67	50	0	0	21	33	50	0	0	0

K. pneumonia, the predominant etiologic organism of RTI in this study showed moderate to high susceptibility to the Imipenem and varying degree of susceptibility to other commonly used antibiotics. *E. coli*, the predominant etiologic organism of UTI in this study showed moderate to high susceptibility to the fluoroquinolones (ciprofloxacin) and varying degree of susceptibility to other commonly used antibiotics (Table 1 and 3). Earlier studies conducted in Nigeria by Ehinmidu (2003), in Kuwait by Al Sweih *et al.* (2005), in India by Tambekar *et al.* (2006) have reported good susceptibility of the bacteria to fluoroquinolones. However, resistance to fluoroquinolones is on the increase in the locality of our study.

The isolated bacteria showed wide differences in their susceptibility to the tested antimicrobial antibiotics (Table 2 and 3). Most of the bacteria recovered from RTI showed the highest degree of susceptibility from Amikacin, Imipenem, Chloramphenicol, Piperacillin+tazobactum, Astreonam, Augmentin(amox+clav), Cefotaxime, Gentamycin, Netilmycin, Tobramycin, Meropenem and Ofloxacin. The same manner was also observed in UTI bacteria (Table 3)

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The high prevalence of resistance to the community used antibiotics such as ampicillin, ciprofloxacin and tetracycline has caused considerable alarm (Janet, 2006; Nurullaev, 2004; Orrett *et al.*, 2006). The most effective antimicrobial agents in our study were Amikacin, Imipenem, Chloramphenicol, Piperacillin+tazobactum, Astreonam, Augmentin (amox+clav), Cefotaxime, Gentamycin, Netilmycin, Tobramycin, Meropenem and Ofloxacin for Gram negative bacilli and Gram positive cocci. Based on the results of this study, the efficacy of amikacin was comparable to other reports (Kothari *et al.*,2008). In a recent study done by Devanand Prakash and Ramchandra Sahai Saxena in adjoining Meerut city, their bacterial isolates were comparable to our study, nalidixic acid was found to be the most resistant drug followed by ceftazidime. In their study most sensitive drug against all uropathogens was meropenem followed by imipenem (Devanand Prakash and Ramchandra Sahai Saxena, 2013).

In conclusion, the data obtained from this study suggest that while RTI and UTI causing pathogens are still susceptible to the imipenem and ciprofloxacin, resistance to these antibiotics is on the increase. Other commonly prescribed antibiotics in RTI and UTI such as nalidixic acid, tetracycline, Erthromycin, ampicillin, Linizolid, Penicillin are rather ineffective and may have lost their value in the chemotherapy of RTI and UTI. It is concluded that Gram negative bacilli (enterobacteracae) were responsible for majority of RTIs and UTIs and most of the strains were multidrug resistant. The most common isolated bacteria from respiratory tract infection was *K. pneumonia* and urinary tract infection was *E. coli*, most effective antimicrobial agents against Gram negative bacilli were Amikacin, Imipenem, Chloramphenicol, Piperacillin+tazobactum, Astreonam, Augmentin(amox+clav), Cefotaxime, Gentamycin, Netilmycin, Tobramycin, Meropenem and Ofloxacin. Sensitivity of a RT pathogen and UT pathogen to a particular antibiotic vary from time to time and across different areas. To reduce the incidence of resistance, empirical antibiotic selection in treatment of RTI and UTI must be based on the knowledge of local prevalence of causative RT and UT pathogens and their respective antimicrobial sensitivities rather than on universal guidelines. Indiscriminate prescription and use of antibiotics must be discouraged in both community and hospital settings by continuous public awareness and education on rational antibiotic use as well as adoption of strict national antibiotic policy to regulate the prescription, sale and use of antibiotics.

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