

Incidence of Methicillin-resistant Staphylococcus Aureus (MRSA) Causing Nosocomial Infection in a Tertiary Care Hospital

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Methicillin-resistant Staphylococcus aureus (MRSA) causing nosocomial infection is the most common pathogen emerging rapidly in Hospitals causing boils, pustules, impetigo, osteomyelitis and occasionally shock syndrome. Colonization with MRSA in health workers is more likely to cause infections and results in higher morbidity and mortality. Respiratory tract, open wounds and intravenous devices are potential sites for infection in admitted patients. 1st MRSA was reported in 1961 in United Kingdom and from USA in 1968. Now MRSA accounts for 40 – 70% of infections in ICUs. In this study, 265 MRSA samples were collected from different departments of tertiary care hospital according to NCCL protocol using control strains ATCC 29213 (oxacillin susceptible) and S. aureus ATCC 43300 (oxacillin resistant). Relative predominance was observed in Males 155 (58.5%). Majority of patients were between age group 41 – 80 years. Most of the samples were collected from MICU and sputum samples yield was highest. Routine antimicrobial sensitivity of MRSA showed 28.7% to Ciprofloxacin, 37.5% to Gentamycin, 35% to Clindamycin, 27.5% to Erythromycin, 18% to fusidic acid, 8% to Penicillin, 87% to Moxifloxacin, 0% to Oxacillin, 100% to Vancomycin, Teicoplanin, Linezolid and Teigecycline. MRSA is more prevalent in ICUs patients. Vancomycin, Teicoplanin, Linezolid and Teigecycline are effective antimicrobials. Spread of Vancomycin resistant has not been acknowledged by this study and in neighboring countries like India, Iran and Bangla Desh.

Key words: MRSA, Nosocomial infection.

Introduction

Staphylococcus aureus, causing nosocomial infection is a versatile and dangerous pathogen emerging rapidly in hospitals, usually infecting skin causing boils, pustules and impetigo. In systemic infections, it causes osteomyelitis, mastitis, septicemia, wound infection and occasionally toxic shock syndrome.¹⁻³ Methicillin-resistant Staphylococcus aureus (MRSA) is a multi-drug resistant isolate, resistant to Macrolides, lincosides, aminoglycosides and beta-lactams which include Penicillin and Cephalosporins.⁴ Staphylococcus aureus can colonize the anterior nares of healthy individuals, who may carry MRSA asymptotically for few weeks to many years. Colonization with MRSA in health workers is dangerous and more likely to cause infection and results in higher morbidity, mortality than colonization or bacteremia caused by methicillin-sensitive S. aureus.⁵⁻⁸

In hospital admitted patients, respiratory tract, open wounds, intravenous catheters and urinary tract are potential sites for infection. Hospital acquired MRSA infection is defined as, occurring in a patient whose MRSA isolate was cultured more than 48 hours after admission or who has a history of hospitalization, surgery, dialysis or residence in a long term health care facility within six months prior to the culture date or had an indwelling intravenous line, catheter or any other percutaneous medical device present at the time, the culture was taken.⁹⁻¹¹

MRSA was 1st reported in 1961 from United Kingdom, shortly after methicillin's induction in clinical practice,¹² from USA in 1968¹³ and Later on from Japan, Europe, and Australia.¹⁴ Now MRSA is one of the most common causes of nosocomial infections accounting for 40% to 70% of S.

aureus infections in intensive care units (ICUs).¹⁵⁻¹⁷

The treatment options of MRSA are limited to few antibiotics like Vancomycin, Linezolid and Teigecycline.¹⁸⁻¹⁹ Reports of reduced susceptibility and resistance of S. aureus to Vancomycin from Japan and USA²⁰⁻²³ transpires the need for determination of current prevalence of MRSA and anti microbial sensitivity pattern in our hospital using newly introduced antibiotics like Linezolid and Teigecycline along with Vancomycin, Teicoplanin and Fusidic acid in patients admitted to different departments of a tertiary care teaching hospital (HA-MRSA) in Lahore.

Materials and Methods

This retrospective study was conducted over a period of four years (From August 2005 to July 2009) at tertiary care teaching hospital with 450 beds in Private Sector at Lahore. Two hundred and sixty five (265) isolates of MRSA were collected from culture samples received from different departments of the hospital. The isolates were consecutive and non repetitive (One per patient). One sample from one patient was inclusion criteria of study data, 2nd sample from other site of same patient was not considered for study.

In Microbiology Lab, samples were cultured on Blood, Mac-Conkey, CLED and Chocolate agars for 24-48 hours. Identification of organisms were carried out by standard laboratory operating procedures according to CLSI guidelines.^{24,25} Gram staining and bio-chemicals like catalase, coagulase and DNase were used. Methicillin-resistant Staphylococcus aureus was evaluated by Kirby-Bauer disc diffusion technique which was conventional and economical. Inoculums were adjusted at 0.5% McFarland standard in

0.9% saline. All *Staphylococcus aureus* isolates were streaked uniformly on the blood agar plates to obtain a confluent growth. 1 µg oxacillin discs were placed and plates were incubated at 30°C for 18–24 hours aerobically. Strains showing an inhibition zone of less than 10 mm were considered as Methicillin-resistant *Staphylococcus aureus* (MRSA).²⁶

Anti microbial susceptibility testing was performed on Muller-Hilton (MH) agar plates according to NCCLS protocol. *S. aureus* ATCC 29213 (oxacillin susceptible) and *S. aureus* ATCC 43300 (oxacillin resistant) strains were used as control and susceptibility profile of *Staphylococcus aureus* was determined against a panel of antimicrobials²⁷⁻²⁸ (Table 4). We used student t test and P value for obtaining the statistical significance of our findings and results.

Results

According to the inclusion criteria, two hundred and sixty five MRSA strains were identified during four years study period. Data was categorized according to the parameters namely gender, age, referring department and type of specimens. Relative MRSA predominance was observed in males 155 (58.5 %) cases, 110 (41.5 %) in female patients, Male to female ratio was 1:0.7 (Table and Fig. 1). Majority of patients 170 (64.1%) were in age group 41-80 years. 144 (54.3%) samples from MICU and the highest number of MRSA (102) were collected from sputum samples accounting for 38.4 % of the total isolate of the study.

Table 2: Incidence of MRSA in different age groups and referring Departments. N = 265.

Age Distribution (years)			Referring Department		
	N	% age		N	% age
1 – 20	30	11.32	MICU	144	54.34
21 – 40	52	19.62	Medical and Allied	58	21.89
41 – 80	170	64.15	Surgical and Allied	38	14.34
81 – 100	13	4.91	SICU	25	9.43
Total	265	100.00	Total	265	100.00

Table 3: Frequency of MRSA in various specimens. N = 265.

Specimens	N	% age
Sputum	102	38.49
IV catheters/ETT/suction tips etc.	76	28.68
Pus	65	24.53
Blood	17	6.42
Urine	5	1.89
Total	265	100.00

Gender groups (n=265)

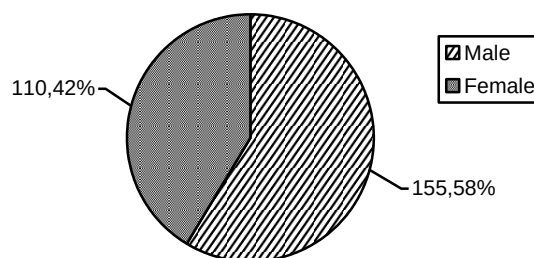


Table 1: Frequency of MRSA in gender groups. n=265.

Incidence of MRSA was 144 (54.34 %) from MICU, 58 (21.89%) from Medical and allied, 38 (14.34%) from surgical and allied and 25 (9.43%) from SICU patients. Data shows higher frequency of MRSA in MICU followed by Medical and allied, Surgical and allied and then SICU (Table 2).

MRSA isolates were collected from sputum, Intravenous catheters, ETT, suction tips, pus, blood and urine. Out of 265 cases, 102 (38.4%) were from sputum, 76 (28.6%) from IV catheters/ETT/suction tips etc., 65 (24.5%) from pus/wound swabs, 17 (6.4%) from blood and 5 (1.8%) from urine cultures. Sputum samples showed maximum growth of MRSA followed by I.V. catheters/ETT/suction tips etc., pus, blood and urine samples in descending order (Table 3).

Routine antimicrobial susceptibility of (MRSA) strains showed 28.7% to Ciprofloxacin, 37.5% to Gentamycin, 35% to Clindamycin, 27.5% to Erythromycin, 18% to Fusidic acid, 8% to Penicillin, 87% to Moxifloxacin, 0% to Oxacillin, 100% to Vancomycin, Teicoplanin, Linezolid, and Teigecycline (Table 4).

Discussion

MRSA is a major nosocomial isolate in hospitals which is responsible for higher morbidity and mortality. Sources of MRSA are infected patients, asymptomatic colonized hospital staff and hands of health care workers serving in ICUs on MRSA positive cases.²⁹

MRSA strains are resistant to several antibiotics like Macrolides, lincosides, aminoglycosides and Beta-lactam penicillin and cephalosporins. Emergence of MRSA has not only caused therapeutic problems in hospitals but also put a tremendous pressure on resources for controlling their spread.³⁰⁻³²

Two hundred and sixty five patients were included in this study. Among them, 155 were male and 110 were female. Male to female ratio was 1:0.7 (Table 1). Majority

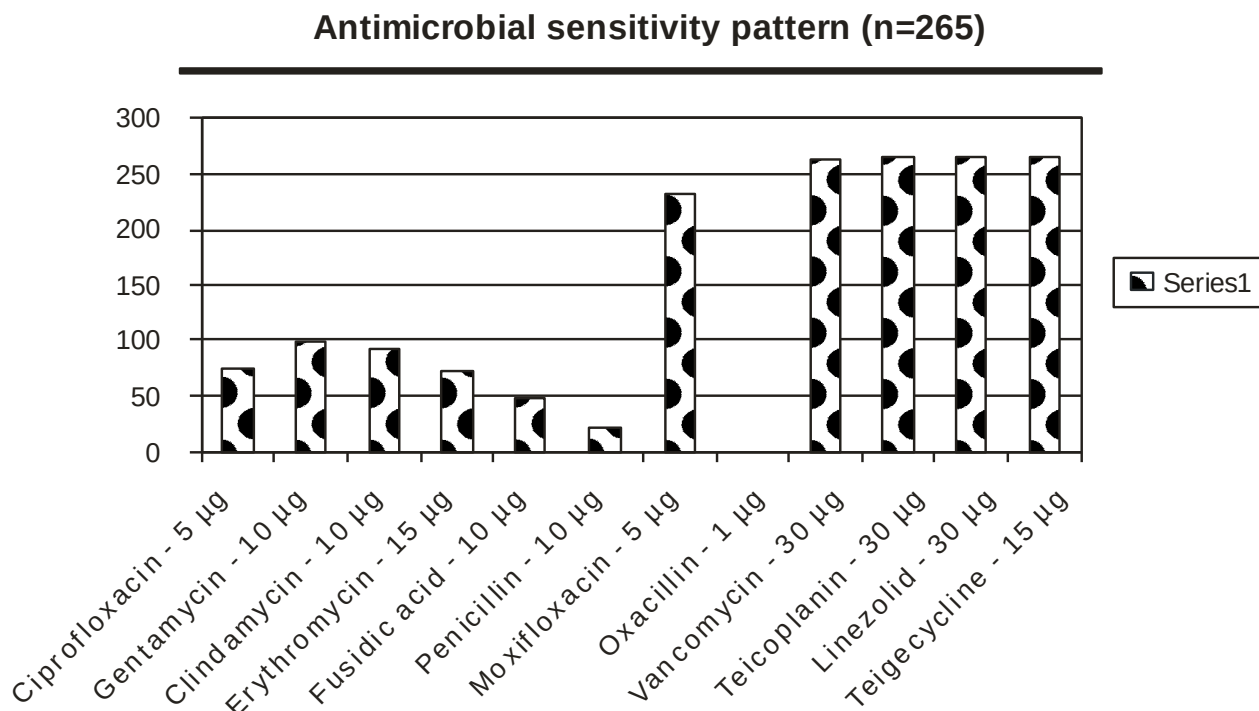


Table 4: Antimicrobial sensitivity pattern of MRSA strains. N = 265.

of patients (64.1%) were between the ages of 41-80 years, 20% in age group of 21-40 years and only 11% patients were in younger age group, 11-20 years (Table 2) indicating MRSA infection is common in working and old age patients. Similar age group patients are frequently infected by MRSA are reported in studies conducted at Malaysia, Kenya and India.³³⁻³⁵

MRSA Incidence was higher in sputum samples, 102 out of 265 (38.4%). The higher incidence of positive sputum sample is probably due to the fact that MICU of teaching hospital is always flooded with patients having Endotracheal intubation. In this study positive pus samples are 65 (24.5%) and IV tip samples are 76 (28.6%) of total isolates (Table 3). M. Aghazadeh et al and Mehta reported 35.3% and 33% MRSA from pus respectively in their studies conducted at Iran and India which are more or less in accordance with the present study. Qureshi in contrast to our study reported up to 83% MRSA from pus samples received from different departments of the hospital and only a few patients from ICU. Studies from Nepal,²³ South Africa,²⁴ Saudi Arabia,²⁵ Ireland²⁶ and Colombia³³ have reported their findings which are in accordance with our study.³⁶⁻⁴¹

Though reduced susceptibility and resistance of *Staphylococcus aureus* to Vancomycin has been reported from Japan and USA. Their spread has not yet been acknowledged by our study as well as studies from Rawalpindi,⁴² Karachi,⁴³ Temilnido,⁴⁴ Utter perdish,⁴⁵ Romania⁴⁶ and CZ Ch. Republic.⁴⁷ Keeping in view these reports, we tested MRSA isolates against a panel of antimicrobials along with Teicoglycine and Linezolid, Oxacillin, Fusidic acid, Eryth-

romycin, Ciprofloxacin, Gentamycin and Clindamycin (Table 4). The susceptibility pattern showed excellent coverage to MRSA with intravenous drugs like Teicoglycine, Teicoplanin, Vancomycin and oral preparation Linezolid. Ciprofloxacin and Erythromycin showed reduced activity only 27 to 28%. Penicillin was the least effective against MRSA (only 8%). The results of our study are supporting the other studies conducted nationally and internationally in Pakistan, India, Colombia and Romania etc.⁴⁸⁻⁵¹

Based on in vitro susceptibility data, Teicoglycine has a broad spectrum activity against complicated skin and soft tissue infections, caused by MRSA and against ESBL producing isolates. Seventy (70) MRSA isolates were tested with Teicoglycine after its induction to panel of antimicrobials in Nov. 2008. 100% sensitivity was observed. Our results and the reports from other national and international studies suggest that Teicoglycine is a good choice and not yet been influenced by any of the resistance mechanisms which are involved in other antimicrobials.⁵²⁻⁵⁵

Linezolid, the 1st oral anti MRSA antibiotic was tested against 130 MRSA isolates by disc diffusion method and found 100% susceptibility. It is not only effective against MRSA but also against other Gram Positive isolates including Vancomycin Resistant Enterococci and Pneumonia caused by them especially in ICUs. Linezolid inhibits synthesis of bacterial protein through binding to the domain V region of 23 S rRNA gene.⁵⁶⁻⁵⁸ Resistance to linezolid is a difficult and complex mechanism and requires mutations of multiple gene copies. So, linezolid is also safe and effective oral drug against MRSA.

Conclusion

MRSA is more prevalent in patients requiring intubation and who are seriously sick especially in ICUs. Vancomycin resistant *Staphylococcus aureus* has not been isolated in this study. Vancomycin, Teicoplanin, Linezolid and Tigecycline are effective against MRSA. These drugs should not be used as empirical therapy. Other wise there are ample chances for development of resistant strains which would be resistant to almost all antibiotics.

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