

Prevalence of Methicillin Resistant Staphylococcus Epidermidis in Biomaterial Related Infections

1. Muhammad Irfan Khan 2. Muhammad Asif Durrani 3. Saleem Ahmed Kharal
4. Mukesh Kumar 5. Syed Manzoor Iqbal Chisty 6. Jai Kirshan Ambwani

1. Dept. of Microbiology 2. Assoc. Prof. of Microbiology 3. Prof. of Microbiology 4, 5 & 6. M.Phil Students, Dept. of Microbiology, BMSI, JPMC, Karachi

ABSTRACT

Objective: To determine the prevalence spectrum of methicillin resistant Staphylococcus epidermidis in biomaterial infections.

Study Design: Experimental and Observational Study.

Place and Duration of Study: This study was conducted in the department of Microbiology, Basic Medical Sciences Institute, Jinnah Postgraduate Medical Centre, Karachi, during the period of January 2010 to Dec. 2010.

Materials and Methods: A total of 300 subjects of all ages and sex were included. Swab from cannulae tips, catheters tips, old cannulae infected wounds, injection abscess were collected from Jinnah Postgraduate Medical Centre, National Institute of Child Health and Civil Hospital, Karachi and processed according to standard laboratory methods.

Results: A total 103 methicillin resistant Staphylococcus epidermidis, causing biomaterial related infection, isolated from 300 patients were analyzed. Bacterial pathogens were commonly isolated from patients of all ages who developed biomaterial related infections.

Conclusion: Patients suffering from infections related with biomaterial should be monitored for MRSE at regular intervals.

Key Words: Staphylococcus epidermidis, cannula, catheter tip.

INTRODUCTION

Staphylococcus epidermidis is a gram positive coagulase negative cocci that is part of our normal flora (Nilsson et al., 1998)¹. It is one of the most significant bacteria in context of hospitalized infection (Nomura et al., 2010). Catheter infections along with catheter induced UTI's lead to serious inflammation and pus secretions (Nilsson et al., 1998)¹.

Staphylococcus epidermidis is one of the five most common organisms that cause nosocomial infections due to the increase in usage of biomaterials in the clinical environment (Mack et al., 2007).²

Resistance to methicillin in staphylococci is known to be associated with the presence of mec A gene, which codes for a penicillin binding protein with low affinity for β -lactam antibiotics (Miraglia et al., 2007).³

Staphylococcal infection in hospitalized patients has been a major concern for well over a century (Ekrami et al. 2010).⁴ They expressed methicillin resistance which involves all beta lactam antibiotics and leads to a significant limitation in therapeutic options.

Infections caused by Staphylococcus epidermidis are persistent and relapsing which further complicates treatment of biomaterial infections (O'gara, 2001)⁵. Between 35 and 66% of clinically important coagulase negative staphylococci are resistant to methicillin (Keramidas et al., 2003).⁶

The infection by methicillin resistant coagulase negative staphylococci, such as Staphylococcus epidermidis tends to show a higher level of prevalence (60-70%) (Buonavoglia et al. 2010).⁷

The inherent capacity of this organism to cause infection derives primarily from its ability to form mucoid biofilms on inert synthetic surfaces of indwelling medical devices. At biochemical level extracellular polysaccharide adhesion play an essential role in initial bacterial adherence and intercellular adhesion (O'gara, 2001).⁵

Intravenous access lines and needles connectors have been demonstrated to be a risk factor for blood stream infection (Chaieb et al., 2005).⁸

It is clear that Staphylococcus epidermidis is an important cause of bacteremia and has been correlated with the increase in the use of prosthetic and indwelling devices and the growing number of immune-compromised patients in hospitals (Jeong, 2002).⁹

The number of multiple resistant strains including methicillin resistant coagulase negative staphylococci has increased (Jain, 2004).¹⁰

Methicillin resistant Staphylococcus epidermidis has proven to be an infection associated with hospitalization. The routes of transmission are through to be patient-to-patient and patient-to-medical professional-to-patient (Nomura et al., 2010).¹¹

MATERIALS AND METHODS

Study site: The study was performed in Microbiology Department of BMSI, JPMC, Karachi from January 2010 to December 2010.

Enrollment: 300 patients of all ages were selected from medicine, surgery and paediatric Departments. Samples were collected from cannulae tips, catheter tips, cannulae infected wounds, operated wound infection with the help of sterile swab. Swabs were inoculated into peptone water that was used as transport medium. Specimen were streaked on blood agar and MacConkey's agar plates and incubated overnight at 37°C aerobically. Phenotypic characteristics of the colonies were used for presumptive identification of *Staphylococcus epidermidis*. *Staphylococcus epidermidis* identification was confirmed by gram staining, catalase test and coagulase test and inoculation on Mannitol salt agar. The isolates were gram positive cocci with catalase positive, coagulase negative with no fermentation on mannitol salt agar.

Final identification was made by Kirby-Bauer disc diffusion method as recommended by the National Committee for Clinical Laboratory Standards Institute (2005). The bacterial colonies introduced after following the procedure as described by McFarland. The following antibiotic disks (Oxoid-UK) were used; Oxacillin (1µg), Novobiocin (5µg), Methicillin (10µg). The isolates were inoculated on Mueller Hinton agar and incubated at 37°C for 24 hours to assess the susceptibility of the isolates to methicillin. The isolates were taken as methicillin resistant if the zone of inhibition was <10mm for oxacillin, < 9 mm and for novobiocin > 16mm.

RESULTS

A total of 300 clinically suspected cases of biomaterial related infections attending OPDs or indoor patients in surgical department, medicine department and Paediatrics Department from JPMC, NICH, LGH and CHK were included in this study and yielded 103 (34.3%) methicillin resistant *Staphylococcus epidermidis*.

Table 1 shows out of 300 cases 103 (34.3%) methicillin resistant *Staphylococcus epidermidis* were isolated.

Table No.1: Occurrence of MRSE in patients

No. of patients	Positive for MRSE	Percentage
300	103	34.3%

Table 2 shows hospital wise distribution with MRSE. 100 samples from JPMC with 38 (38%) positive, 100 samples from CHK with 37 (37%) positive and 100 samples from NICH with 28 (28%) positive cases respectively.

Table No.2: Distribution of MRSE positive specimens according to hospital

Hospital	No. of patients	Positive for MRSE	Percentage
JPMC	100	38	38%
CHK	100	37	37%
NICH	100	28	28%

Table 3 shows age wise distribution of patients with MRSE. 28 out of 100 (28%) cases were found in 0-12 years age group, 12 out of 25 (48%) in 12-18 years age group, 23 out of 48 (47.9%) in 18-30 years, 15 out of 41 (36.5%) in 30-40 years of age, 12 out of 43 (27.9%), 6 out of 21 (28.5%) in 50-60 years of age, 5 out of 11 (45.4%) in 60-70 years, 2 out of 8 (25%) in 70-80 years of age and finally 1 out of 3 (33.3%) in 80-90 years of age respectively.

Table No.3: Distribution of patients with MRSE in different age groups

Age group (Years)	No of patients	Positive for MRSE	Percentage
0-12	100	28	28.0%
12-18	25	12	48.0%
18-30	48	23	47.9%
30-40	41	15	36.5%
40-50	43	12	27.9%
50-60	21	06	28.9%
60-70	11	05	45.4%
70-80	08	02	25.0%
80-90	03	01	33.3%

Table 4 shows distribution of MRSE according to gender. Of the 300 specimens, 132 (44%) were female showing 48 (36.3%) positive for MRSE while 84 (63.6%) were negative for MRSE. 168 (56%) specimens were taken from male patients out of which 55 (32.7%) were positive for MRSE and 115 (68.4%) were negative for MRSE.

Table No.4: Distribution of MRSE on the basis of gender

Gender	No of patients	Positive for MRSE	Negative for MRSE
Female	132 (44%)	48 (36.3%)	84 (63.6%)
Male	168 (56%)	55 (32.7%)	115 (68.4%)

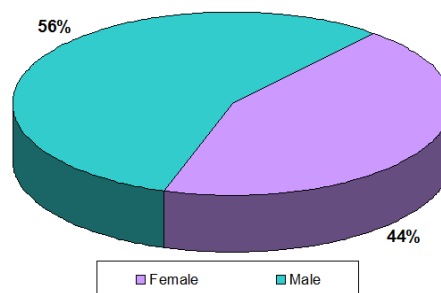


Figure: Distribution of MRSE on the basis of gender

Table 5 shows the results of MRSE isolated on the basis of department. 50 specimens were taken from medicine department showing 18 (36%) positivity for MRSE and 32 (64%) were not positive for MRSE. 200 specimens were collected from department surgery showing 76 (38%) positive for MRSE and 124 (62%) negative for MRSE. 50 specimens were collected from Paediatric department showing 14 (28%) positive for MRSE and 36 (72%) negative for MRSE.

Table No.5: Distribution of MRSE according to department

Department	No of patients	Positive for MRSE	Negative for MRSE
Medicine	50	18 (36%)	32 (64%)
Surgery	200	76 (38%)	124 (62%)
Paediatrics	50	14 (28%)	36 (72%)

Table 6 shows the results of MRSE isolated on the basis of the sample type. 167 samples were from operated wound infections showing 60 (35.9%) positive for MRSE, 63 samples were taken from cannulae wound infections out of which 21 (33.3%) were positive for MRSE. 47 samples were taken from Injection abscess out of which 17 (36.1%) were positive for MRSE. 23 samples were collected from tips of cannulae catheters showing 5 (21.7%) positive for MRSE.

Table No.6: Distribution of MRSE according to sample type

Sample site	Number of patients	Positive for MRSE
Operated wound infections	167	60 (35.9%)
Cannulae wounds infection	63	21 (33.3%)
Infection abscess	47	17 (36.1%)
Catheter tips and cannula tips	23	5 (21.7%)
Total:	300	103

DISCUSSION

Methicillin resistant *Staphylococcus epidermidis* are the common cause of infections associated with the use of catheters, cannulae, sutures, injection needles in both indoor and outdoor hospital patients. The present study was conducted to determine the prevalence of biomaterial related infections due to methicillin resistant *Staphylococcus epidermidis*.

The purpose of this study was to assess the frequency of MRSE in infections associated with biomaterial culture and biochemical tests were performed for isolation of MRSE. In this study out of a total 300 cases MRSE were isolated among 103 (34.3%).

This study supports the finding that most common etiological agent of biomaterial related infection is methicillin resistant *Staphylococcus epidermidis*. Yameen et al. (2010)¹² stated that the prevalence rate of

methicillin resistant *Staphylococcus epidermidis* in hospitalized patients were 29.78%.

Chaieb et al. (2005)⁸ mentioned that *Staphylococcus epidermidis* is responsible for 33.5% of nosocomial blood stream infections. Intravenous access lines and needles connectors have been demonstrated to be a risk factor for blood stream infection. In a study done by Chaieb et al. (Tunisia) in 2007, a high frequency of *Staphylococcus epidermidis* (72%) isolated from biomaterials. A significant study of neonatal infections was conducted in Naples by Villari et al. (2000)¹⁴. Results found indicated that *Staphylococcus epidermidis* was the pathogen leading to blood stream infections (39.8%). Surface infections (29.8%) and meningitis (58.3%) also related to the use of biomaterials. In accordance to study conducted by Manikandan et al. in 2005¹³ the prevalence of *Staphylococcus epidermidis* (57.1%) in hospitalized patients and is resistant to methicillin and oxacillin. In another study conducted by Mohanty et al. (2007)¹⁵ the prevalence of *Staphylococcus epidermidis* in surgical patients is 34.5%.

In accordance to another study conducted in surgical wards of JPMC the prevalence of *Staphylococcus epidermidis* was 46.8% (Budvi, 2007).

Keramidas et al. (2003)⁶ mentioned the prevalence of methicillin resistant *Staphylococcus epidermidis* between 35 to 66%. In another study by Buonavoglia et al. (2010),⁷ *Staphylococcus epidermidis* shows a higher level of prevalence (60-70%) demonstrating the ability of staphylococci to spread from hospital environment to community.

CONCLUSION

Methicillin resistant *Staphylococcus epidermidis* tends to show a higher level of prevalence. These most susceptible to infection are intravenous users, new borns, elderly, and those using catheters as artificial appliances. Infections caused by MRSE are often persistent and relapsing, and it have the ability to spread from hospital environment to community and to colonize health individual.

The alarming increase in prevalence of MRSE suggested to fully assess its importance, it may be essential to determine its species, prevention, and treatment as no particular pattern can be predicted in any problematic situation.

Patients suffering from infections related with biomaterial should be monitored for MRSE at regular intervals.

REFERENCES

1. Nilsson M, Frykberg FJ, Pei L, Lindberg M, Guss B. A fibrinogen binding protein of *Staphylococcus epidermidis*. *Infect Immunity* 1998;66(5):2666-2673.

2. Mack D, Davies A, Harris L, Rhode H, Horskotte M, Knobloch J. Microbial interactions in Staphylococcus epidermidis biofilms. *Analyt Biochem* 2007;387:399-408.
3. Miragaia M, Thomas JC, Cuoto I, Enright MC, Leneastre H. Inferring a population structure for Staphylococcus epidermidis from multilocus sequence typing data. *J Bacterial* 2007; 189(6): 2540-2552.
4. Ekrami A, Samarbafzadeh A, Alavi M, Kalantar E, Hamzeloi F. Prevalence of methicillin resistant staphylococcus species isolated from burn patients in a burn center, Ahvaz. *Iran Judishpur J Microbiol* 2010;3(2):84-91.
5. O'gara JP, Humphreys H. Staphylococcus epidermidis biofilms: importance and implications. *J med Microbiol* 2001; 50:582-587.
6. Keramidas E, Rodopoulou S, Iconomou T, Tsati E, Loannovich J. Methicillin resistant Staphylococcus epidermidis infection insensitive to teicoplanin. A case report and a review of the literature. *Microbiol* 2000; 38(5):1740-1746.
7. Buonavogtia A, Latronico F, Greco MF, Abramo MD, Marinaro M, Mangini F, et al. Methicillin resistant staphylococci carriage in the oral cavity: a study conducted in Bari (Italy). *Oral Dis* 2010.
8. Chaieb K, Abbass MS, Touati A, Hassen AB, Mahdouani K, Bakhrouf A. Molecular characterization of Staphylococcus epidermidis isolated from biomaterials in a dialysis service. *Ann Microbiol* 2005; 55(4):207-312.
9. Jeong J, Chang CL, Park TS, Lee SH, Kim SR, Jeong SH. Early screening of oxacillin resistant Staphylococcus aureus and Staphylococcus epidermidis from blood culture. *J Korean Med Sci* 2002; 17:168-172.
10. Jain A, Agarwal J, Bansal S. Prevalence of methicillin resistant, coagulase negative staphylococci in Neonatal intensive care unit. *J Med Microbiol* 2004; 53:941-944.
11. Nomura K, Mizumachi E, Yamashita M, Oshiro M, Komori T, Sugai M, et al. Drug susceptibility and clonality of methicillin resistant Staphylococcus epidermidis in hospitalized patients with hematological malignancies. *Ir J Med Sci* 2010; 481:487.
12. Yameen MA, Nasim H, Akhtar N, Iram S, Javed I, Hameed A. Antibiotic susceptibility profile of methicillin resistant staphylococci isolated from nasal samples of hospitalized patients. *Afr Microbiol Res* 2010; 4(3):204-209.
13. Manikandan P, Bhaskar M, Revathy R, John RK, Narendran K, Narendran V. Speciation of coagulase negative staphylococcus causing bacterial keratitis. *Indian J Ophthalmol* 2005; 53:59-60.
14. Villari P, Sarnataro C, Lucazio L. Molecular epidemiology of Staphylococcus epidermidis in a neonatal intensive care unit over a three year period. *J Clin Microbiol* 2000; 38(5):1740-1746.
15. Mohanty S, Kapil A, Das BK, Dhawan B. Antimicrobial resistance profile of nosocomial uropathogens in a tertiary care hospital. *Indian J Med Sci* 2003; 57:148-154.

Address for Corresponding Author:**Dr. Muhammad Irfan Khan,**

Dept. of Microbiology,

BMSI, JPMC, Karachi.