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ASSESSING THE RESISTANCE TO MUPIROCIN IN MRSA-INFECTED INDIAN INDIVIDUALS

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ABSTRACT

Background: MRSA (Methicillin-resistant Staphylococcus aureus) is a prevalent infection linked with enhanced multidrug resistance in a variety of therapeutic situations. With an increasing immediate need to combat MRSA infection, the use of mupirocin as a decontamination strategy has increased dramatically.

Aim: The current study aims to investigate resistance to mupirocin in MRSA-infected people from an Indian background.

Methods: In the current investigation, Staphylococcus infection was detected in 130 analysed samples using normal conventional phenotypic techniques. Kirby Bauer's disc diffusion technique was used to measure antibiotic susceptibility in µg/ml mupirocin, while MIC (minimum inhibitory concentration) was determined using MIC E-test strips.

Results: The study found that all bacterium strains had MIC values <4 µg/ml, 24 strains had MUC in the range of 0.123 to 0.638 µg/ml, and 46 isolates had MIC values between 0.03 and 0.17 µg/ml. However, in the current investigation, 10 MRSA isolates showed no zone of resistance to mupirocin E-strip.

Conclusions: The current study suggests that the majority of the isolates are responsive to mupirocin, which is encouraging given that mupirocin is a potential drug for the eradication of MRSA strains, which are a serious issue in clinical practice. Using 5µg mupirocin discs provides a cost-effective alternative to mupirocin E-strips, especially in clinical settings where resources are restricted. However, the current investigation found no significant difference in sensitivity between the disc technique and E-strips.

Keywords: antibiotic resistance, Mupirocin, MRS, staphylococcus infection, MIC, minimal inhibitory concentration.

INTRODUCTION

Staphylococcus aureus is a well-known widespread bacterium that may colonize skin surfaces and anterior nares but usually causes no illnesses in healthy people. However, if it persists in the systemic circulation, it can cause a variety of dangerous illnesses. Currently, antibiotic treatment is problematic due to the spread of MRSA (multi-drug-resistant methicillin-resistant Staphylococcus aureus) strains. MRSA has been identified as a primary route of multi-drug resistance in nosocomial pathogens, resulting in a large incidence of infections in these people.1

Even decades after its discovery, Staphylococcus aureus remains a famously harmful bacteria for humans. The rate of hospital-acquired and community-acquired staphylococcal infections has significantly increased, with little to no influence on overall death rates. S. aureus's effectiveness as a human pathogen stems from its capacity to have a wide variety of consequences due to dominating toxins and virulence factors. Increased resistance of S. aureus to broad-spectrum antimicrobial drugs, along with its prevalence as a nosocomial infection, poses a significant challenge and burden on the global health sector. Resistant phenotypes are typically linked with S. aureus persistence in hospital settings, resulting in the establishment of strains resistant to methicillin.[2]

Studies conducted in India revealed that MRSA isolates are susceptible to vancomycin. Cephalosporin, Penicillin, Gentamicin, Erythromycin, and Cotrimoxazole were discovered to be resistant. In the late nineteenth century, a variety of antibiotics were discovered to be effective in the treatment of bacterial illnesses. However, the emergence of clinical strains resistant to broad antibiotics, as well as bacterial population emergence with increased antimicrobial resistance, is possible due to a variety of factors such as drug use in the animal field as enhancers, usage in animal feed, and irrational antimicrobial use. The majority of clinical isolates of S. aureus currently exhibit penicillin resistance. Management of MRSA infections is complicated because to resistance to beta-lactam medicines such as penicillin and methicillin. MRSA strains associated with hospital infections are generally multidrug resistant, leaving reserved medicines as the primary choice.3

Staphylococcal infections can be treated with mupirocin, which is a decolonizing agent. With an urgent requirement to remove or restrict MRSA infection, there is a greater chance of utilizing mupirocin against MRSA infection, which is a nasal decolonisation regimen. To evaluate the use of mupirocin as a decontamination regime in clinical settings, it is necessary to study the epidemiology, etiology, and clinical importance of mupirocin resistance, which can be a significant step toward reducing the formation of MRSA strains. This increasing irrational usage of a few antibiotics contributed to endemic outbreaks due to the presence of resistant MRSA bacteria at low and high levels, resulting in the evolution of resistance to mupirocin.4

However, low-level resistance dissemination is becoming more substantial, and there is less possibility that it will have a big impact on clinical practice. Implementations are being developed to limit the spread of mupirocin resistance in MRSA strains, which will play an important role in monitoring the function of mupirocin in clinical practice.5 The current study sought to better understand the resistance pattern and susceptibility of clinical isolates of MRSA strains to mupirocin, as well as to determine the MIC (minimum inhibitory concentration) against MRSA strains using E-strip.

MATERIALS AND METHODS

The current cross-sectional clinical investigation sought to better understand the resistance pattern and susceptibility of clinical isolates of MRSA strains to mupirocin, as well as to determine the MIC (minimum inhibitory concentration) against MRSA strains using E-strips.

The research subjects were examined at the Institute's Department of Microbiology. All individuals provided verbal and written informed consent before to participation. The study's inclusion criteria were participants who had their samples microbiologically analyzed and showed signs of MRSA infection. The investigation excluded samples that included microorganisms other than MRSA. The individuals were selected using a purposive sample strategy and based on the presence of MRSA infection.

In this investigation, 130 MRSA samples were detected and evaluated. Urine, blood, endotracheal aspiration (ET), pus, nose swabs, and ear swabs were all collected. Staphylococcus infection was detected using normal biochemical and culture procedures.

Kirby Bauer's disc diffusion method was used to determine antimicrobial susceptibility for 5 µg/ml of mupirocin. Standard antibiotics such as clindamycin, erythromycin, gentamycin, daptomycin, linezolid, and vancomycin were used to impregnate the discs. The MIC was assessed using 0.064-1024 mcg/ml of MIC E-test strips of mupirocin, with isolates having sensitivity of 512 µg/ml considered high resistant and MIC in the range of 8 to 256 µg/ml considered low resistance. Strains with a reading of <4 µg/ml were considered sensitive after MRSA strains were evaluated using an automated system with antibiotic oxacillin at a dosage of 4 µg/ml.

Statistical analysis of the collected data was performed using SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk, NY, USA) for descriptive measures, Student t-test, ANOVA (analysis of variance), Pearson correlation coefficient, and Chi-square test. The data were presented in the form of mean and standard deviation, as well as frequency and percentage. A p-value of <0.05 was considered.

RESULTS

The current cross-sectional clinical investigation sought to better understand the resistance pattern and susceptibility of clinical isolates of MRSA strains to mupirocin, as well as to determine the MIC (minimum inhibitory concentration) against MRSA strains using E-strips. In the current investigation, 130 samples of MRSA were detected and evaluated.

Urine, blood, endotracheal aspiration (ET), pus, nose swabs, and ear swabs were all collected. For the 130 samples, sample type was put in 81.5% (n=106) subjects and 27.7% (n=36) subjects, respectively: surgical ward, geriatric from 24.6% (n=32) subjects, surgery ICU in 18.5% (n=24), private wards in 13.8% (n=18), blood in 9.2% (n=12), orthopedics and ET swab in 7.7% (n=10), ENT in 6.2% (n=8), and CSF and burns ICU in 1.5% (n=2) subjects (Table 1).

Diabetes mellitus was diagnosed in 27.7% (n=36) of the study subjects, followed by breast abscess, sepsis, infected wound, non-healing ulcers, swelling, carbuncle, furuncle, and gangrene in 15.4% (n=20), 3.8% (n=18), 7.7% (n=10), 4.6% (9n=6), 4.6% (n=6), 3.1% (n=4), 1.5% (n=2), and 1.5% (n=2) subjects, respectively. Other infections were detected in 20% (n=26) of the research participants (Table 2).

In examining the sensitivity of MRSA isolates against mupirocin strips and mupirocin disc in study isolates, mupirocin disc and strips demonstrated sensitivity in 100% (n=2) samples with a non-significant difference and p=1.000. In ET swabs, all 100% (n=10) samples were sensitive to mupirocin disc and strips, with no significant difference (p = 1.000).

Blood samples demonstrated 100% sensitivity in both mupirocin discs and strips, with no significant differences and p=1.000. However, in pus cultures, considerably more samples shown sensitivity with mupirocin disc, with 90.6% (n=96) samples compared to 9.4% (n=10) resistant samples with both mupirocin disc and strips, with p=0.000 indicating a large statistical difference (Table 2).

The study found that all bacterium strains had MIC values <4 µg/ml, 24 strains had MUC in the range of 0.123 to 0.638 µg/ml, and 46 isolates had MIC values between 0.03 and 0.17 µg/ml. However, in the current investigation, 10 MRSA isolates showed no zone of resistance to mupirocin E-strip.

The bulk of MRSA isolates were found in the surgical ward and surgery ward. The majority of MRSA isolates were from patients with diabetes, breast abscesses, and sepsis. All ten mupirocin-resistant strains originated from pus samples.

DISCUSSION

In this investigation, 130 MRSA samples were detected and evaluated. Urine, blood, endotracheal aspiration (ET), pus, nose swabs, and ear swabs were all collected. For the 130 samples, sample type was put in 81.5% (n=106) subjects and 27.7% (n=36) subjects, respectively: surgical ward, geriatric from 24.6% (n=32) subjects, surgery ICU in 18.5% (n=24), private wards in 13.8% (n=18), blood in 9.2% (n=12), orthopedics and ET swab in 7.7% (n=10), ENT in 6.2% (n=8), and CSF and burns ICU in 1.5% (n=2) subjects. These findings were consistent with earlier studies by Dardi CK et al6 in 2014 and Boyce JM et al7 in 2001, in which authors tested people for MRSA resistance using identical research samples as the current investigation.

Diabetes mellitus was diagnosed in 27.7% (n=36) of the study subjects, followed by breast abscess, sepsis, infected wound, non-healing ulcers, swelling, carbuncle, furuncle, and gangrene in 15.4% (n=20), 3.8% (n=18), 7.7% (n=10), 4.6% (9n=6), 4.6% (n=6), 3.1% (n=4), 1.5% (n=2), and 1.5% (n=2) subjects, respectively. Other infections were detected in 20% (n=26) of the research participants. These findings were consistent with those of Oommen SK et al8 in 2010 and Treneva MS et al9 in 2015, who reported clinical diagnoses of diverse samples obtained similarly to the current investigation in their separate studies.

The study results indicated that while comparing the sensitivity of MRSA isolates against mupirocin strips and mupirocin disc in study isolates, in two CSF samples, mupirocin disc and strips exhibited sensitivity in 100% (n=2) samples with a non-significant difference (p=1.000). In ET swabs, all 100% (n=10) samples were sensitive to mupirocin disc and strips, with no significant difference (p = 1.000). Blood samples demonstrated 100% sensitivity in both mupirocin discs and strips, with no significant differences and p=1.000. However, in pus cultures, considerably greater samples shown sensitivity with mupirocin disc, with 90.6% (n=96) samples compared to 9.4% (n=10) resistant samples with both mupirocin disc and strips (p=0.000), indicating a significant difference.

These findings were consistent with the findings of Rajkumari N et al10 in 2014 and Mostafa MS et al11 in 2020, who both found comparable sensitivity of MRSA isolates against mupirocin strips and mupirocin disc in their research participants, as shown in the current investigation. All bacteria strains exhibited MIC values <4 µg/ml, whereas 24 strains had MUC between 0.123 and 0.638 µg/ml and 46 isolates had MIC between 0.03 and 0.17 µg/ml. However, in the current investigation, 10 MRSA isolates showed no zone of resistance to mupirocin E-strip.

The bulk of MRSA isolates were found in the surgical ward and surgery ward. The majority of MRSA isolates were from patients with diabetes, breast abscesses, and sepsis. All ten mupirocin-resistant strains originated from pus samples. These findings were consistent with the findings of Enright MC et al12 in 2002 and Sunagar R et al13 in 2016, who found strains of the bacterium with MIC values close to the current research.

CONCLUSION

Despite its limitations, the current study shows that the majority of the isolates are responsive to mupirocin, which is encouraging given that mupirocin is a potential drug for the eradication of MRSA strains, which are a serious issue in clinical practice. Using 5µg mupirocin discs provides a cost-effective alternative to mupirocin E-strips, especially in clinical settings where resources are restricted. However, the current investigation found no significant difference in sensitivity between the disc technique and E-strips.

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TABLES

S. No	Parameter	Number (n)	Percentage (%)
1.	**Sample type**		
a)	Pus	106	81.5
b)	Burns ICU	2	1.5
c)	ENT	8	6.2
d)	Orthopedics	10	7.7
e)	Private wards	18	13.8
f)	Surgery ICU	24	18.5
g)	Geriatric	32	24.6
h)	Surgery	36	27.7
i)	CSF ward	2	1.5
j)	ET swab	10	7.7
k)	Blood	12	9.2

Table 1: Distribution of Staphylococcus infection based on sample type, ward, and site in study subjects

S. No	Diagnosis (Clinical)	Number (n)	Percentage (%)
1.	**Gangrene**	2	1.5
2.	**Furuncle**	2	1.5
3.	**Carbuncle**	4	3.1
4.	**Swellings**	6	4.6
5.	**Non–healing ulcers**	6	4.6
6.	**Infected wound**	10	7.7
7.	**Sepsis**	18	13.8
8.	**Breast abscess**	20	15.4
9.	**Diabetes mellitus**	36	27.7
10.	**Other**	26	20
11.	**Total**	130	100

Table 2: Clinical diagnosis of various samples collected from the study subjects

S. No	Sample type	MRSA isolates	Mupirocin disc		Mupirocin strip		p-value
			Sensitive n (%)	Resistance n (%)	Sensitive n (%)	Resistance n (%)	
1.	**CSF**	2	2 (100)	0	2 (100)	0	>0.005
2.	**ET swab**	10	10 (100)	0	10 (100)	0	>0.05
3.	**Blood**	12	12 (100)	0	12 (100)	0	>0/05
4.	**Pus**	106	96 (90.6)	10 (9.4)	96 (90.6)	10 (9.4)	**0.000**
5.	**Total**	130	120 (92.3)	10 (7.7)	120 (92.3)	10 (7.7)	>0.05

Table 3: Sensitivity of MRSA isolates against mupirocin strips and mupirocin disc in study isolates