Original Research Article

Identification and antibiotic susceptibility pattern of Staphylococcus aureus with special reference to methicillin resistant Staphylococcus aureus in tertiary care hospital

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International Archives of Integrated Medicine, Vol. 10, Issue 2, February, 2023.
Available online at http://iaimjournal.com/
ISSN: 2394-0026 (P) **ISSN: 2394-0034 (O)**
Received on: 20-1-2023 **Accepted on:** 30-1-2023
Source of support: Nil **Conflict of interest:** None declared.

How to cite this article: Shraddha Gadara, Jayshri Pethani, N. M. Shaikh, Hiral Shah, Siddhi Mesariya, Keyur Chauhan. Identification and antibiotic susceptibility pattern of Staphylococcus aureus with special reference to methicillin resistant Staphylococcus aureus in tertiary care hospital. IAIM, 2023; 10(2): 1-6.

Abstract

Background: The emergence of Methicillin-resistant Staphylococcus aureus (MRSA) has posed a serious therapeutic challenge. It is responsible for a wide range of infections including superficial skin infections, food poisoning, osteomyelitis and septicemia. Aim of this study was to identify and to determine antibiotic susceptibility pattern of Staphylococcus aureus from various clinical samples.
Materials and methods: Different clinical specimens were collected and processed for routine culture and antibiotic sensitivity test by standard microbiology techniques.
Results: A total of 129 S. aureus strains were isolated from various clinical specimens out of which 84 (65.12%) were Methicillin Resistance Staphylococcus aureus (MRSA). 66(51.16%) S. aureus were obtained from indoor (IPD) patients. S. aureus was found higher in male than female. S. aureus was found highly resistant to Benzylpenicillin (94.57%) followed by ciprofloxacin (77.51%), Erythromycin (61.24%), and Cotrimoxazole (51.94%), Clindamycin (44.19%), and Gentamicin

(17.05%). 1 (0.78%) of the isolates were resistance to Vancomycin and Linezolid. For urine isolates Nitrofurantoin was drug of choice.

Conclusion: Methicillin resistant Staphylococcus aureus was found 65.12% of Staphylococcus aureus isolates. It was most common in males and hospitalized patients. Teicoplanin or Tigecyline seems to be drug of choice followed by Vancomycin, Linezolid, Tetracycline and Gentamicin. It would be helpful to formulating and monitoring the antibiotic policy and ensure proper empiric treatment.

Key words

Staphylococcus aureus, MRSA, Antibiotic susceptibility, Healthcare associated infection.

Introduction

Staphylococcus aureus is a catalase and coagulase positive gram-positive cocci. S. aureus is by far the most important human pathogen among the staphylococci. It is found in the external environment and in the anterior nares of 20% to 40% of adults. Other sites of colonization include intertriginous skin folds, perineum, axillae, and vagina [1].

Although this organism is frequently a part of the normal human microflora, it can cause significant opportunistic infections under the appropriate conditions.[1]It is responsible for a wide range of infections including superficial skin infections, food poisoning, osteomyelitis and septicemia [2].

Resistance to commonly used antimicrobial drugs is frequently encountered with S. aureus. Some of the mechanisms in resistance include; inactivation of antibiotics by the enzymes, decreased affinity for the antibiotics caused by alteration of the target, efflux pumps, and trapping of the antibiotic [3].

Multidrug-resistant strains particularly Methicillin Resistant Staphylococcus aureus (MRSA) strains are common causes of healthcare associated infection and are associated with increased morbidity and mortality [4, 5].

Vancomycin, a tricyclic glycopeptide antibiotic, is used to treat Gram-positive infections involving MRSA [9, 10].

The emergence of antibiotic resistant bacteria constitutes a major problem in antibiotic therapy. The aim of the present study is to establish the incidence of S. aureus in clinical specimens and its antibiotic sensitivity pattern to various antibiotics.

Materials and methods

Our study included specimens that were collected between December 2021 and November 2022. In this study 9240 different clinical specimens (urine, blood, pus, sputum, swab, fluid, CSF and tips) were collected for routine culture and antibiotic susceptibility testing and were processed according to the standard microbiology laboratory techniques.

Smears were made from the samples (except blood) and Gram's staining was performed. The specimens were cultured on blood agar and MacConkey agar plates and incubated at 37°C for 24 hours.

For identification and antibiotic susceptibility automated VITEK-2 Compact system was used. It detects metabolic changes by fluorescence-based methodswhich facilitate the identification of bacteria within 6 hours reducing turnaround time for identification.

For identification of Gram Positive organism GP card used. It contains 43 tests measuring carbon source utilization, enzymatic activity and resistance. Identification cards were inoculated with microorganism suspensions of 0.5

McFarland standards from a plate of pure culture.

For antibiotic susceptibility, AST P628 card used which included following antibiotics:
Ciprofloxacin, Clindamycin, Daptomycin, Erythromycin, Gentamicin, Levofloxacin, Linezolid, Oxacillin, Benzylpenicillin, Rifampicin, Trimethoprim/ Sulfamethoxazole, Tetracycline, Teicoplanin, Tigecycline, Vancomycin, *Nitrofurantoin. (*used only for urine isolates)

Methicillin resistance which was tested by phenotypic cefoxitin screen test.

Results

From 9240 various clinical samples 2883(31.20%) samples were culture positive, others were culture negative or normal flora. Out of 2883 cultures positive cases, 129 (4.47%) S. aureus were isolated.

In present study, 66(51.16%) S. aureus were obtained from in patient department (IPD) patients admitted in surgery, medicine, orthopedic, pediatrics etc., 32(24.81%) from Intensive care unit (ICU) patients, and 31(24.03%) from outpatient department (OPD).

Out of 129 S. aureus 70 (54.26%) were isolated from male and 59 (45.74%) were isolated from female (**Table – 1**).

Table - 1: Age and Gender wise distribution of S. aureus.

	Total	**Percentage**
Male	70	54.26%
Female	59	45.74%

All isolates were analyzed by specimens, out of 129 S. aureus 45 (34.63%) were isolated from pus, 37 (28.68%) were isolated from blood, 28 (21.71%) from swab, 13 (10.08%) were isolated from tissue, 4 (3.10%) were isolated from urine, 1 (0.78%) from tracheal secretion and 1 (0.78%) was isolated from fluid (**Table – 2**).

Table - 2: Specimen wise distribution of S. aureus.

Specimen	**Total**	**Percentage**
Pus	45	34.63%
Blood	37	28.68%
Swab	28	21.71%
Tissue	13	10.08%
Urine	4	3.10%
Tracheal secretion	1	0.78%
Fluid	1	0.78%
Total	129	100%

Table - 3: Antibiotic resistance pattern of S. aureus.

Antibiotic	**Resistance**
Benzylpenicillin	122 (94.57%)
Ciprofloxacin	100 (77.51%)
Erythromycin	79 (61.24%)
Cotrimoxazole	67 (51.94%)
Clindamycin	57 (44.19%)
Gentamicin	22 (17.05%)
Rifampicin	5 (3.88%)
Tetracycline	5 (3.88%)
Linezolid	1 (0.78%)
Vancomycin	1 (0.78%)
Teicoplanin	0 (0%)
Tigecycline	0 (0%)
Daptomycin	0 (0%)
Nitrofurantoin*	0 (0%)

* used only for urine isolates

Antibiotic susceptibility pattern of S. aureus showed that isolates were highly resistance to Benzylpenicillin 122 (94.57%) followed by Ciprofloxacin 100 (77.51%) Erythromycin 79 (61.24%), Cotrimoxazole 67(51.94%), Clindamycin 57 (44.19%), and Gentamicin 22 (17.05%).

However, 1 (0.78%) of the isolates were resistance to Vancomycin and Linezolid. There was no resistance seen for Teicoplanin, Tigecycline, Daptomycin and Nitrofurantoin*. (*used only for urine isolates).

Out of 129 isolates 84 (65.12%) were Methicillin Resistance Staphylococcus aureus (MRSA). Only 1 (0.78%) was Vancomycin Resistance Staphylococcus aureus (VRSA) as per **Table - 3**.

Discussion

Despite the introduction of antimicrobial therapy and the recent improvements of medical services, MRSA is recognized as a major cause of healthcare associated infections which result in significant morbidity and mortality.

Total 129 (4.47%) S. aureus were isolated from 2883 positive culture. The number of S. aureus isolated was high in indoor patients (51.16%) than OPD (24.03%). This difference could be due to prolonged hospital stay, instrumentation and other invasive procedures. Study conducted by Bhatt CP et al showed that Inpatients department showed maximum number of S. aureus (54%) and outpatient department showed (46%) [12].

Finding of this study showed that S. aureus were found higher in male 54.26% than female 45.74%. Another study performed by Khanal, et al. the rate was significantly higher among males (75%) than females (25%) [13].

In present study, highest 45 (34.63%) S. aureus were isolated from pus, followed by 37 (28.68%) were isolated from blood, and 28 (21.71%) from swab. In studies done by Tiwari, et al. [14] and Arora, et al. [15] S. aureus reported from pus were 63.7% and 51.2%, from blood were 10.5% and 31.6% respectively which differ with the results of present study.

The unrestricted use of antibiotics and inadequate compliance to antibiotic regime along with inadequate surveillance for anti-microbial resistance are some of the imperative reasons for the emergence of its highly resistant strains [7, 8].

S. aureus was found highly resistant to Benzylpenicillin (94.57%), ciprofloxacin (77.51%), Erythromycin (61.24%), and Cotrimoxazole (51.94%). Study done by Bhatt CP, et al. [12] showed similar resistance pattern for Benzylpenicillin (100%). Study done by Arora, et al. [15] showed 52.8 % resistance to ciprofloxacin. Studies done by Tiwari, et al. [14] and Arora, et al. [15] showed 71.7% and 50.2% resistance to Erythromycin respectively. Another study performed by Gitau, et al. [16] showed similar resistance pattern (57%) to cotrimoxazole.

In our study, 17.05% S. aureus were resistance to Gentamicin. This compares favorably with reports published by Gitau, et al. [16] and Bhatt CP, et al. [12], which is 13% and 15% respectively.

Methicillin resistant Staphylococcus aureus (MRSA) infection has been associated with long hospital stays, numerous or prolonged antibiotic courses, the presence of invasive devices and proximity to an already infected or colonized patient [6].

In present study 65.12% Methicillin Resistance Staphylococcus aureus (MRSA) were isolated. Study conducted by Tiwari, et al. [14] showed 69.1% MRSA isolation rate, which is similar to present study. Another study conducted by Arora, et al. [15] showed 46% MRSA prevalence.

Antibiotic susceptibility pattern of S. aureus showed 0.78% resistance to Vancomycin. On comparison with study done by Bhatt CP, et al. [12]; Tiwari, et al. [14] and Arora, et al. [15] showed similar 0% resistance pattern for vancomycin. Study conducted by Khanal, et al. [13] showed 21% resistance to vancomycin. That study indicates the emergence of Vancomycin Resistant S. aureus (VRSA).

Conclusion

In our study, 129(4.47%) S. aureus were isolated from total 2883 positive culture. S. aureus were commonly isolated from male and indoor

patients. For treatment of S. aureus infection Teicoplaninor Tigecyline was drug of choice followed by Vancomycin, Linezolid, Tetracycline and Gentamicin. For urine isolates Nitrofurantoin was drug of choice. 94.57% isolates were resistance to Benzylpenicillin. This study highlights the need for continuous surveillance of antibiotic sensitivity pattern of Staphylococcus aureus and Methicillin resistant Staphylococcus aureus (MRSA) with a view to selecting appropriate therapy. Efforts should, therefore, be made in ensuring proper monitoring of drug administration and its use to prevent drug misuse and abuse as well as to prevent or reduce the rate of anti-microbial resistance amongst clinical pathogens.

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