Antibiotic Effectiveness against *Staphylococcus aureus* Isolated from Clinical Cases in Babylon Hospitals

Emad Noman Hassan Hamza, Suaad Abid Fazaa

Department of Biology, College of Science, University of Al-Qadisiyah, Al-Qadisiyah, Iraq

Abstract

Background: *Staphylococcus aureus*, especially those that are multidrug-resistant, constitute a public health problem worldwide. It has been represented as the most common causative agent of skin infections, wound infections, and bacteremia. **Objective:** The purpose of the current study was to determine the incidence of *S. aureus* antibiotic resistance through bacteria collection from various clinical locations in a number of hospitals in the Babylon province. **Materials and Methods:** During the research, 429 clinical samples were collected from hospitals in the Babylon Health Directorate between July 2022 and February 2023. The samples were cultured in routine selective media, and the bacterial isolates were found according to different testing biochemically. The disc diffusion method was used in an antibacterial sensitivity test. **Results:** Of 429 different specimens, 284 (66.2%) showed bacterial growth. After using manual methods to identify species, 171 (60.21%) of 284 isolates are *Staphylococcus spp*. From 171 Staph species, 61 (35.67%) were *S. aureus*. These isolates award a maximum rate of sensitivity to nitrofurantoin (90%) and chloramphenicol (95%) and showed a maximum ratio of resistance to penicillin (91%) and cefoxitin (85%). **Conclusion:** High prevalence of *S. aureus* 61 (35.67%) from 171 *Staphylococcus* species. Antibiotics indicated a high ratio of sensitivity to nitrofurantoin (90%) and chloramphenicol (95%) and indicated a high ratio of resistance to penicillin (91%) and cefoxitin (85%). The purpose of the current study was to determine the incidence *S. aureus* antibiotic resistance through bacteria collection from various clinical locations in a number of hospitals in the Babylon province.

Keywords: Antibiotic effectiveness, MDR, quinolones MRSA, Staph species, *Staphylococcus aureus*

Introduction

Staphylococcus aureus is one of the common causative agents of infections.[1] There are 30 species of bacteria in the *Staphylococcus* genus, which is diverse in nature. According to several studies, *S. aureus* is the species with the greatest clinical importance and has a widespread prevalence in nature. *S. aureus* is transmitted by air from one person to another by droplets.[1,2] *S. aureus* is one of the most common germs to infect people, and it can lead to infections of the skin, wounds, and bacteremia. Even though the fatality rate of *S. aureus* infections has dropped with the discovery of antibacterial agents, the bacteria have already developed responses to several antibacterial drugs.[1,3]

Methicillin-resistant *S. aureus* (MRSA) was identified and found more than 50 years ago. The MRSA straining of *S. aureus* is resistant to methicillin drug. *S. aureus* resistant to oxacillin was employed as a standard for methicillin in sensitivity tests.[2] Aggressive infections produced by *S. aureus* were commonly lethal before the use of antibiotics.[4] Human-associated bacteria were more than two times greater in an inhabited indoor climate, despite the fact that the population structure in indoor air roughly correlated with that of the outdoor air.

The spread of MRSA worldwide has become the main issue facing the management of illnesses acquired in hospitals today.[5] MRSA has a strong resistance to all beta-lactam drugs. This makes the management and

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Address for correspondence: Mr. Emad Noman Hassan Hamza, Department of Biology, College of Science, University of Al-Qadisiyah, Al-Qadisiyah, Iraq. E-mail: nmanmad2@gmail.com

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treatment of infections affected by these organisms quite difficult challenging and expensive.[6,7]

MRSA is accountable for almost 60% of all *S. aureus* infections in US healthcare facilities according to the research from the Centers for Disease Control and Prevention in 2004. *S. aureus* was the most frequent source of bloodstream infections acquired in hospitals, and the ratio of MRSA insulates bigger about 22% in 1995 and increased to 57% in 2001.[4,8] However, data from the National Hospital-Acquired Infections Monitoring System show that the proportion of MRSA isolates has increased to approximately 60% in intensive care units.[1,6,8] According to recent reports, MRSA infections in the community are now the main cause of *S. aureus* skin and soft-tissue infections in the community.[9] Around 15% of reported illnesses are thought to be community-associated, meaning they happened in people without known risk factors for healthcare.[10,11]

Vancomycin is presently the solitary antibiotic approved for utilization in the treatment of MRSA contaminations.[11] Rare clinical insulates of *S. aureus* that are resistant to vancomycin have recently been reported.[8] The advent of *S. aureus* insulates resistance to vancomycin, and a widespread variety of structurally unrelated drugs has raised MRSA into an multi-drug resistant "Superbug," creating it supplementary deadly than always in a hospital situation and, more lately, in the healthy population.[12,13] The purpose of the current study was to determine the incidence of *S. aureus* antibiotic resistance through bacteria collection from various clinical locations in a number of hospitals in the Babylon province.

Materials and Methods

Our research involved 429 specimens that were isolated between July 2022 and February 2023. All clinical samples were received and gathered via the designated hospitals' lab departments. Bacterial samples were isolated from outpatients and hospitalized patients in various wards who were of both sexes and all age groups. Clinical samples were collected from a variety of infected body locations, comprising wounds, sputum, urine, and blood. Clinical samples were acquired utilized accepted assembly methods such as swabs, saliva and blood.[14,15] For 24 h, the Petri plates were incubated aerobically at 37°C.

Standard procedures[16] were used to identify isolates for any possible clinically considerable growth that appeared on the culture medium depending on the growth culture feature, source, and location of the sample. Basic microbiological techniques, including bacterial growth morphology and main biochemical tests such as Gram staining, coagulase, and catalase, were used to make the first identification.[14] The bacteria recovered from clinical samples were finally identified, and an auto-analyzer system was used to determine their susceptibility to antibiotics.

The antibiotic discs that used in this study were penicillin (P, 10 mg), cefoxitin (FOX, 30 mg), azithromycin (AZM, 15 mg), chloramphenicol (C, 30 mg), gentamicin (GN, 10 mg), erythromycin (E, 15 mg), oxacillin (OX,1 mg), methicillin (MET, 5 mg), ciprofloxacin (CIP, 5 mg), and vancomycin (V, 30 mg).

Ethical approval

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients' verbal and analytical approval before the sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee according to the document number 1987 (including the number and the data on June 20, 2022) to get this approval.

Results

From the 429 clinical samples, 284 (66.2%) demonstrated growth. Based on the results of culture on the various selective medium, catalase, coagulase, and Gram staining, 171 (60.21%) of 284 revealed *Staphylococcus* species, whereas 61 (35.67%) of 171 showed the morphological and biochemical characteristics of *S. aureus* [Table 1].

From 34 bacterial growth in burns, 11 (32.35 %) were *S. aureus*. From 34 bacterial growth in wounds, 19 (55.88%) were *S. aureus*. From 87 bacterial growth in sputum, 17 (19.54) were *S. aureus*. From 128 bacterial growth in urine infection, 14 (10.93) were *S. aureus* [Figure 1].

Bacterial sensitivity to antibiotics

To detect possible drug resistance in common pathogens and to assure susceptibility to drugs of choice for particular infections, the antimicrobial susceptibility testing is performed for the study purpose.[16] 61 isolates of *S. aureus* were examined in accordance with CLSI 2021, it is being studied in relation to 15 antibiotics using the method of disk diffusion. Table 2 displays the proportions of bacterial isolates that are highly resistant, moderately resistant, and sensitive to antibiotics.

S. aureus indicated a high ratio of sensitivity to nitrofurantoin (90%) and chloramphenicol (95%) and indicated a high ratio of resistance to penicillin (91%) and cefoxitin (85%).

Table 1: Distributing of microorganisms from various sources

Specimen origin	Specimen	Positive growth culture	*Staphylococcus sp.*	*S. aureus* No. (%)
Burns	78	34	21	11 (32.35)
Wounds	42	34	13	19 (55.88)
Sputum	138	87	51	17 (19.54)
Urine infection	171	128	86	14 (10.93)
The total number	429	284	171	61

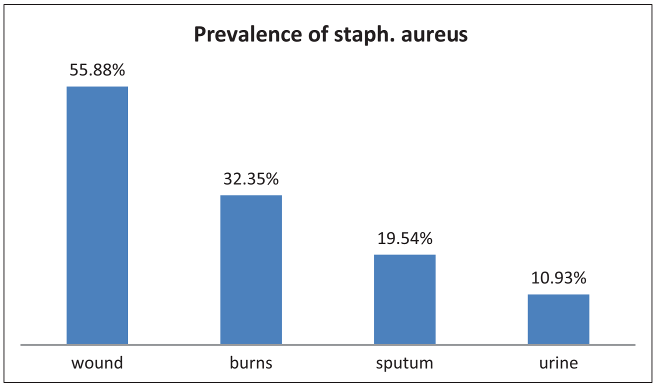

Figure 1: Prevalence of *S. aureus* among different specimens

Table 2: Incidences of susceptibility tests for 61 isolates

Antibiotics	Resistant	Intermediate	Sensitive
Penicillin	91%	5%	4%
Cefoxitin	85%	4%	11%
Moxifloxacin	61%	0%	39%
Erythromycin	59%	15%	26%
levofloxacin	42%	8%	50%
Amikacin	35%	20%	45%
Ofloxacin	34%	7%	59%
Tetracycline	31%	0%	69%
Rifampin	19%	0%	81%
Norfloxacin	15%	0%	85%
Trimethoprim	15%	0%	85%
Gentamicin	15%	0%	85%
Ciprofloxacin	12%	0%	88%
Nitrofurantoin	9%	1%	90%
Chloramphenicol	5%	0%	95%

Ratio of antibody resistance between MRSA and methicillin sensitive *S. aureus* isolates

Antimicrobial resistance is a growing problem and a threat to public health. It occurs due to germs developing the ability to drub the antimicrobial agents designed to kill them.[17] When investigating antibiotic sensitivity, particularly, MRSA strains demonstrated better antibiotic resistance than methicillin sensitive *S. aureus* bacteria. The maximum resistance to penicillin is 91%, and the minimum resistance to chloramphenicol is 5%. Methicillin sensitive *S. aureus* strains showed the highest sensitivity to chloramphenicol with a ratio of 95% and the lowest sensitivity to penicillin with a ratio of 4%, as shown in Table 2, and intermediates to eight antibiotics, including moxifloxacin, tetracycline, rifampin, norfloxacin, ciprofloxacin, trimethoprim, gentamicin, and chloramphenicol, with a ratio of 0%.

Discussion

S. aureus has been identified as a significant individual illness. The pathogenesis and ferocity of it are linked with its ability to yield numerous virulence factors.[4] It has been proven that the bacteria MRSA is resistant to antibiotics such as amoxicillin, methicillin, penicillin, and oxacillin. It is spread throughout the world healthcare facilities, where it was responsible for various infections. Hospital-acquired infections are a problem for patients in addition to the healthcare system, so they are associated with rise in hospitalization expenses as well as high death and illness rates.[2,8]

The results of the current investigation revealed that *S. aureus* was common in burns (32.35%), wounds (55.88%), sputum (19.54), and the urinary tract (10.93%). According to a different study, 80% of *S. aureus* infections in hospitals and the general population are endogenous, meaning they are caused by the colonizing strain when it enters the body through any route,[18] It is the most common reason for nosocomial pneumonia and surgical wound infections. In addition, it is the main reason for nosocomial bacteremia.[19]

The susceptibility test results indicated a distinct change in the cause of the controlled bacterial segregates. Research on the antibiotics utilized indicated that the samples had the top average level of antibiotic resistance to penicillin with a ratio of 91%, and this outcome was nearly what was established in the research.[20] Chloramphenicol resistance where the results we gained are like to what was discovered in the study,[21] the ratio of bacterial resistance to it was determined to be 80%, which is lower than what was discovered there.[22]

As for quinolone drugs, the antibiotic ofloxacin logged a 34% resistance rate against drugs such as fluoroquinolones, and this is the same ratio that was showed in searches.[23] Both ciprofloxacin and norfloxacin were resistant to the isolates with a ratio of 12% and 15%, respectively. The resistance to the antibiotics Levofloxacin and erythromycin is 42% and 59%, respectively.[24,25] While moxifloxacin is found at 61%, which is somewhat near to the ratio found in the study.[26] where the ratio of resistance to the antibiotic is 64%. The results of the nitrofurantoin antibiotic resistance study are very close to 9% of the study.[27]

The isolates showed a resistance ratio of 19% to the antibiotic rifampin, making it greater than the ratio that researchers in an Iraq study reached to.[21] The aminoglycosides, such as gentamicin and amikacin, are effective against clinically significant Staphylococci due to their interference with protein synthesis.[28] As well 15% of the isolates were found to be resistant to the antibiotic gentamicin,[29] While the isolates had a 35% resistance rate to the antibiotic Amikacin,[30] the widespread method by which these antibiotics have acquired resistance in *S. aureus* also in other ways of resistance include aim variation, object mutants, and mutations.[31]

Therefore, it is important to discuss the causes of the variations in these bacteria's proper antibiotic resistance in the research. This is the reason for the indiscriminate and nonselective use of treatments, as the constant presence of bacteria makes the selection of antibiotic-resistant strains unavoidable. Moreover, geographical and climatic health issues may also be related to the relative variation in results[32] between various places.

Conclusion

A high prevalence of *S. aureus* (60.21%) from different specimens has been observed in this study. Antibiotic sensitivity for nitrofurantoin is 90% and chloramphenicol is 95% and showed a high rate of resistance to penicillin (91%) and cefoxitin (85%).

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Conflicts of interest

There are no conflicts of interest.

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