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Prevalence and Antimicrobial Sensitivity Pattern of Staphylococcus saprophyticus isolated from Urinary Tract Infection in Women

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Author`s Contribution

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A B S T R A C T

Background: Staphylococci saprophyticus are Gram-positive, coagulase-negative, non-hemolytic cocci which cause urinary tract infections in young adult women.

Objective: The present study was aimed to investigate the prevalence and antimicrobial sensitivity pattern of S. saprophyticus isolated from young women with urinary tract infection.

Methodology: A total of 100 urine samples were collected from urinary tract infected women at Government General Hospital, Faisalabad. Samples were transported and proceeded in Microbiology laboratory of Riphah international university, Faisalabad. The isolated S. saprophyticus were identified by Gram staining, culture characteristics, biochemical tests and by antimicrobial (Novobiocin) sensitivity test by Modified Kirby Bauer disc diffusion method.

Results: Ninety-four (94) out of 100 urine samples revealed growth of gram positive bacteria, gram negative bacteria and fungi on different culture media. S. saprophyticus was recovered from 3 urine samples. All strains of S. saprophyticus (100%) were found sensitive to imipenem and amikacin. Out of 3, two isolate (66.6%) showed sensitivity against gentamicin and ciprofloxacin. However, all isolated S. saprophyticus were found resistant to pipemidic acid and nitrofurantoin. These findings contribute to the understanding of infections caused by S. saprophyticus and may aid in the selection of appropriate antibiotics for the treatment of urinary tract infections.

Keywords: Urinary tract infection, Staphylococcus saprophyticus, Prevalence, Antimicrobial sensitivity test.

Introduction

Staphylococcus saprophyticus is Gram positive, non-hemolytic and coagulase negative cocci. In women of childbearing age, it is a leading cause of Urinary tract infection (UTI), which in turn can lead to acute pyelonephritis and urethritis.[1,2] Various virulence factors contribute to its pathogenesis. Enzymes in the cytoplasm of *S. saprophyticus* include Urease and D-serine, as well as proteins such as fibronectin binding autolysin, surface associated lipase, uro-adherence factor, and collagen binding serine-aspartate-repeat protein. Surface proteins bound to the cell wall of *S. saprophyticus* activate its hemagglutinin, which helps the bacteria connect to cells in the urinary tract. Because the urethras of women are shorter and closer to the body, they are more likely to get UTIs than men. [3, 4] *S. saprophyticus* has accumulated genetic determinants encoding strong resistance to heavy metals [5] and detoxification of uric acid and D-serine, *S. saprophyticus* is able to persist in hard and toxic environments, which contributes to its effectiveness as a uropathogen.[6] Additionally, it has been reported that *S. saprophyticus* pathogenicity is linked to its ability to stick to uroepithelial cells, which is facilitated by adhesins, surface proteins, and biofilm development.[7] When bacteria invade the bladder and its surrounding structures, it's called a urinary tract infection. It is common for bacteria to enter the urinary tract via the urethra. Urinary tract infections often present with dysuria, pain in the suprapubic region, and increased urination frequency. Kidney stones and the use of spermicide-containing diaphragms as a form of birth control can both significantly increase the likelihood of a urinary tract infection. Lower UTIs affect the lower urinary tract (cystitis) can be painful and uncomfortable. Symptoms of an upper UTI include fever, chills, back or side discomfort, nausea, vomiting, anxiety, disorientation, or agitation. If left untreated, upper UTIs pose a

serious risk of kidney damage or infection in the bloodstream.[8] Due to a lack of routine susceptibility testing, the state of surveillance for antibiotic resistance in *S. saprophyticus* is inadequately documented. The Clinical and Laboratory Standards Institute (CLSI) states that *S. saprophyticus* urine isolates should not be routinely tested for infections since infections are sensitive to antimicrobial agent concentrations in urine, which are often used to treat simple, acute UTIs.[9] It has been shown that *S. saprophyticus* can improve its virulence and antibiotic tolerance by 100 to 1000 times when it forms biofilms, in contrast to non-biofilm-producing isolates.[7] Several mechanisms, such as the encoding of antibiotic-resistant genes, the restriction of drugs, and the counteraction of host immunity, contribute to the biofilm's ability to transmit antibiotic resistance.[10] It is common practice to treat a UTI with a broad-spectrum antibiotic without first conducting a culture and sensitivity test; this is done on an empirical basis. The rise of multi-resistance in bacteria is directly attributable to the global spread of antibiotic resistance, which in turn is caused by the careless and overuse of these drugs.[11] Nearly 25,000 Europeans die each year from complications of UTIs caused by multidrug-resistant (MDR) bacterial strains, according to a study by the European Survey of Antibiotic Consumption.[12]

Methodology

The study was conducted in compliance with ethical guidelines. The study protocol was approved by the institutional review board of Riphah International University, Faisalabad and Government General Hospital, Faisalabad.

This experimental types of study were done at the Department of Medical Laboratory Technology, Riphah International University, Faisalabad. The study was carried out from March, 2023 to April, 2023. Urine samples were collected from female patients either admitted in inpatient department or visited the outpatient department of Government General Hospital, Faisalabad. A total of 100 urine samples were collected from young females suffering from urinary tract infections. The inclusion criteria specify the target population, such as sexually active adult females (18 to 45 years old). Collection and transportation of the samples were done according to standard guidelines of national healthcare facilities. Midstream urine was collected. Once the urine samples were collected, it was ensured that the samples were properly labelled with the patient's name, date, age, and transported to Riphah Microbiology laboratory within 2 hours. The samples were cultured on Blood and MacConkey agar. On blood agar, *S. saprophyticus* colonies appear as bright yellow or white pigment. *S. aureus* displays a light to golden yellow pigment, whereas *S. epidermidis* shows a white pigment. The typical appearance of *Streptococcus* colonies appears as dome-shaped with a smooth or moist surface and clear margins.[13] The isolated bacteria were identified and confirmed by Gram staining, biochemical tests ncluding Catalase and Coagulase tests, and Novobiocin sensitivity testing by following standard protocols. [14]

Antiboitic sensitivity test was performed by modified Kirby-Bauer disc diffusion method and the zone of inhibition was measured by Vernier calliper by following instructions of CLSI.[15] The antibiotic discs used for *S. saprophyticus* were Tobramycin, Amikacin, Fosfomycin, Pipemidic acid, Imipenem, Ciprofloxacin, Gentamicin and Nitrofurantoin.

Results

Out of 100 urine samples, 94 samples were culture positive. Out of these 94 samples, Gram positive bacteria were recovered from 12 samples. While growth of 78 samples were identified as Gram negative bacteria. Out of 12 Gram positive isolates, 7 were identified as Staphylococcus. Out of these 7 Staphylococci, 3 were identified as Coagulase positive (S. aureus) and 4 were identified as Coagulase Negative Staphylococcus species. Out of 4 Coagulase negative Staphylococcus isolates, 3 isolates showed resistance to novobiocin, which indicated S. saprophyticus. The percentage positivity of S. saprophyticus and other microbes isolated from urine samples is summarized in Table I.

Table I: Prevalence of different microbes isolated from urine sample.

Names of Isolates	Number and percentages of Isolates N(%)
Gram negative rods	78(78)
Staphylococcus saprophyticus	3(3)
Staphylococcus aureus	3(3)
Streptoccous	3(3)
Bacillus species	2(2)
Staphylococcus epidermitis	1(1)
Candida	4 (4)
Total	94(100)

All strains of S. saprophyticus (100%) were found sensitive to imipenem and amikacin. Out of 3, two isolate (66.6%) showed sensitivity against gentamicin and ciprofloxacin. However, all isolated S. saprophyticus were found resistant to pipemidic acid and nitrofurantoin. It was observed that 2 out of 3 isolates showed resistance against more than three antibiotics. Antimicrobial sensitivity pattern of S. saprophyticus is given in Table II.

Table II: Antimicrobial sensitivity pattern of *S. saprophyticus* (n=3) isolated from urine sample.

Antibiotic	Sensitive N (%)	Resistant N(%)
Imipenem	3(100.00)	0(00)
Amikacin	3(100.00)	0(00)
Gentamicin	2(66.66)	1(33.33)
Tobramycin	2(66.66)	1(33.33)
Ciprofloxacin	2(66.66)	1(33.33)
Fosfomycin	1(33.33)	2(66.66)
Nitrofurantoin	0(00)	3(100.00)
Pipemidic acid	0(00)	3(100.00)

Discussion

The recent study was conducted at Microbiology laboratory of Riphah International University, Faisalabad, that provide valuable insights into the prevalence and antibiotic sensitivity of *S. saprophyticus*. *S. saprophyticus* was recovered from 3% of UTI infected women in accordance with prevalence rate (3%) of a previous study conducted in Saudi Arabia.[16] Similarly, a low prevalence rate (2%) of *S. saprophticus* from UTI infected women has been documented by a previous study conducted at Dhaka, Bangladesh. [16] A surveillance study conducted in Japan on uncomplicated urinary tract infections (UTIs) reported 5% prevalence of *S. saprophyticus* that is a little bit higher as compared to our study.[17]

In our study, total 94 urine samples were found positive for microbial growth. isolated. Out of 94, 78% were gram negatives rods and 3% were *S. saprophyticus*. In consistence with the present study, a survey of antimicrobial resistance in urinary tract pathogens, carried out in 252 community care centres in 17 countries reported that the most common uropathogens were *E. coli* (53.3%) followed by *S. saprophyticus* (2.5%) among 4,734 females included in the survey.[18] A low prevalence rate of 0.07% of *S. saprophyticus* among UTI infected females has been reported in an old study conducted at Canada.[19] In contrast, another studies conducted at Brazil and Bangladesh revealed high prevalence of *S. saprophyticus* as 25% and 19%, respectively of UTI isolates among young females.[20, 21]

In the present study, All strains of *S. saprophyticus (*100%) were found Nitrofurantoin in contrast with previous studies in which high susceptibility (92%, 100%) of *S. saprophyticus* against Nitrofurantoin have been reported.[22, 23] However, that study reported *S. saprophticus* as the most common Gram positive bacteria isolated from UTI among women in accordance with our study.[22] Moreover, the 100% sensitivity of *S. saprophyticus* against imipenem observed in the present study is in consistency with the results of anothe study conducted in Pakistan recently.[24]

Conclusion

The study result reveals the antimicrobial sensitivity pattern of *S. saprophyticus* infections by Imipenem and Amikacin with 100% sensitivity that may help physicians choose the best medications to treat UTIs. Further study requires to explore the mechanism of resistance and control of *S. saprophyticus*; the most prevalent cause of UTIs in young adult females.

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