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OCCURRENCE OF STAPHYLOCOCCAL INFECTIONS IN A TERTIARY CARE HOSPITAL

Microbiology

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ABSTRACT

Background: Staphylococci are leading causative agents of a wide variety of human infections. These organisms can colonize the anterior nares and skin of individuals, who serve as important reservoirs in hospitals. Cultural analysis is important in such infections to reduce associated morbidity and mortality. **Objectives:** To determine the occurrence, identification and antibiogram pattern of Staphylococci from various clinical samples of patients and to correlate with age, sex, type of sample, clinical diagnosis, ward admitting the patient and associated risk factors. **Methods:** Various clinical samples received in the Department of Microbiology were subjected to primary gram staining and culture on enriched and selective media. The Staphylococci isolated were identified and subjected to antibiogram testing, using standard laboratory procedures. **Results:** The occurrence of Staphylococci was 19.9%. The prevalence of Staphylococcus aureus, MRSA AND CONS was 57.6%, 27.2% and 42.4% respectively. Staphylococcus aureus showed 90.8% sensitivity to Linezolid, while it was 89.3% among CONS. Vancomycin sensitivity was 100% in both Saphylococcus aureus and CONS. Staphylococcal infections were more common in the age group 21-50 years (84.9%). The Male:Female ratio was 1.4:1. Pus and swabs from pyogenic lesions yielded 28.1% and 30.3% isolates respectively. Abscesses and skin / soft tissue infections predominated (59.9%). A total of 27.5% patients with Staphylococcal infections were admitted in the surgical wards. A hospital stay of more than 5 days (39.7%) and Diabetes mellitus (46.4%) were significant associated risk factors. **Conclusion:** Knowledge of the causative agent of any infection along with the antibiogram pattern is important in optimum management and a favorable outcome, especially in life threatening situations.

KEYWORDS

Staphylococcus Aureus, MRSA, CONS

INTRODUCTION

Staphylococci are gram positive bacterial species, found as commensals on the human skin and mucosa. They have been considered as important potential pathogens. They cause a wide variety of infections, ranging from mild skin lesions to life threatening systemic diseases such as bacteremia. These organisms have been incriminated as causative agents of both community and hospital acquired infections.[1]

This group of bacteria includes coagulase positive Staphylococcus aureus and coagulase negative Staphylococcus (CONS). They are further classified as Methicillin resistant or sensitive Staphylococcus aureus (MRSA and MSSA) and Methicillin resistant and sensitive CONS (MR–CONS and MS–CONS).[2]

Infections caused by Staphylococcus contribute significantly to morbidity and mortality and also increase the burden on the healthcare system. Presence of multidrug resistance amongst these bacteria and their ability to cause biofilms pose challenges to physicians.

CONS has emerged as an important hospital pathogen due to advancement in treatment options and use of intravascular catheters and medical implants.[3]

A bacteriological workup of these infections; to isolate the causative agent and assess its antibiogram pattern is imperative to guide the physician in their management. Periodic monitoring of these causative agents along with their susceptibility pattern will assist the physician in life threatening cases requiring empiric antimicrobials.

This study was undertaken to determine the occurrence of Staphylococci from various clinical samples, to ascertain their antibiogram pattern and to assess a clinical correlation with respect to age and gender variables, type of sample, clinical diagnosis and associated risk factors.

MATERIALS AND METHODS

A total of 15860 samples were processed in the Department of Microbiology, Goa Medical College and Hospital, over a period of three months.

Primary gram staining was done on all samples, to look for evidence of pus cells and bacteria. Culture was attempted on solid media i.e. Blood agar and Mackonkey agar and liquid media viz. Glucose broth. Urine samples were processed semi quantitatively, using inoculating loop of 1.3 mm diameter. Caution was taken to culture CSF samples on chocolate agar instead of blood agar. Tissue specimens were ground in a sterile container before culture.

All inoculated media were incubated at 37^0C for 18-24 hours. Growth obtained on culture media was identified by standard techniques.[4] These included colony characteristics, morphology on gram staining, slide and tube coagulase test and biochemical tests, such as catalase test, Hugh Leifson's oxidation fermentation, mannitol fermentation, urea hydrolysis and reduction of potassium tellurite.

Antimicrobial susceptibility testing of the isolates was done by Kirby Bauer disc diffusion method, following CLSI guidelines (2019).[5]

RESULTS

A total of 15860 samples were processed during the study period, out of which bacterial growth was obtained in 3207 samples (20.2%). The occurrence of Staphylococcus amongst all culture positive samples was 19.9% (n=639).

The species of Staphylococcus based on Coagulase test and sensitivity to Methicillin is depicted in Table 1. Staphlyococcus aureus predominated (368 out of 639; 57.6%). Amongst these, Methicillin resistant Staphylococcus aureus accounted for 46.5%. Overall prevalence of MRSA was 27.2%. The occurrence of CONS in the study was 42.4% (n=271), amongst which Methicillin resistant CONS were 68.6%.

The antibiogram pattern of Staphylococcus aureus and CONS is seen in Table 2. A total of 90.8% Staphylococcus aureus isolates showed

sensitivity to Linezolid, followed by 72.6% each to Clindamycin, Teichoplanin, Trimethoprim - Sulphamethoxazole and Doxycycline. All Staphylococcus aureus strains were sensitive to Vancomycin (100%). Sensitivity to Linezolid was 89.3% amongst CONS, followed by 78.6% each to Clindamycin, Teichoplanin, Trimethoprim and Sulphamethoxazole. All CONS isolates were sensitive to Vancomycin (100 %).

Staphylococcal infections were more common in young and middle age groups, ie. 22.4% in age group 21-30 years, 37.9% in age group 31-40 years and 24.6% in the age group 41-50 years. The male : female ratio was 1.4 : 1 (Table 3).

Table 4 shows the isolation of Staphylococci from various clinical samples. Pus and swabs from pyogenic lesions yielded 28.1% and 30.3% isolates respectively, while blood samples grew Staphylococci in 16.8% cases.

Abscesses and skin/soft tissue infections predominated (59.9%), followed by bacteremia (13.2%) and trauma associated lesions (8.8%) (Table 5).

Amongst all patients yielding Staphylococci on culture, 557/639 (87.2%) were indoor cases, whilst outdoor subjects attending the various outpatient departments of the Hospital were 12.8%. Of all admitted cases yielding growth of Staphylococcus, 27.5% were from Surgical wards, 18.1% from Medicine wards and 11.1% from Gynecology wards (Table 6).

Risk factors associated with Staphylococcal infections is depicted in Table 7. Hospital stay of more than 5 days and associated metabolic disorder ie Diabetes mellitus as risk factors were seen in 39.7% and 46.4% subjects respectively.

DISCUSSION

Staphylococci are important causative agents of human infections, contributing to morbidity and even mortality in severe cases.

Occurrence of Staphylococcal infections was 19.9% in the present study, indicating that Staphylococcus is a well established pathogen. Higher prevalence of 43.0% Staphylococcus was observed in the study of Belbase et al.[6] This high prevalence is probably due to inclusion of only pus and wound samples in their study. Arunkumar et al,[1] however, observed a low prevalence of 5%. The subjects in their study were from various critical care units, where gram negative bacilli were more prevalent.

The ecological niche for Staphylococcus is the anterior nares in humans. Individuals with Staphylococcal colonization are important reservoirs in the hospital. These organisms can easily spread through contact with infected individuals or their belongings. It is also possible for healthcare workers to transport Staphylococci from infected to susceptible patients during the discharge of their duties, especially when the wards are overcrowded.

Staphylococcus aureus accounted for 57.6% of all Staphylococcal isolates. The overall prevalence of MRSA was 27.2%. In a study by Bose et al,[7] the prevalence was seen to be 33.5%. Velu et al[8] opine that the prevalence of MRSA is increasing and showing variations across geographic locations.

MRSA pose treatment challenges as they are frequently multidrug resistant. Virulence factors contributing to pathogenicity and spread of MRSA have been elucidated. These include extracellular factors, toxins, invasiveness and biofilm production.[9]

The prevalence of CONS was 42.4% in the present study. Similar findings of 48% occurrence of CONS was observed by Rania et al.[10] These organisms are gaining importance as potentially dangerous pathogens and are often observed in ICU patients. Their low nutritional requirement and presence of potent virulence factors offer a survival advantage to CONS.[6]

In the present study the antibiogram pattern of both Staphylococcus aureus and CONS showed 100% sensitivity to Vancomycin. Linezolid, Teichoplanin and Clindamycin still appear to offer a ray of hope in treatment of Staphylococcal infections, in our settings. Resistance amongst Staphylococci can be tackled by increasing the concentration of the drug or by administering low concentration of combined drugs.[11] Staphylococcal infections were common in the age group 21-50 years (84.9%) in the present study. The male : female ratio was 1.4 : 1. Although these organisms can cause infections in all age group individuals, the prevalence of infection in the age group 21-50 years in the present study is an indication that they are physically active and hence prone to develop infections.

In the present study the source of samples was skin and soft tissue (69.2%), which fortunately can be tackled relatively easily. However, involvement of deep tissues and respiratory tract makes eradication difficult and may lead to invasive disease. Staphylococcal septicemia can be life threatening and may need antibiotics to be started empirically before the antibiogram pattern of the causative pathogen is available.

Clinical diagnosis in patients with Staphylococcal infections was predominantly soft tissue and skin lesions (59.9%) and the areas of hospital harboring these patients were surgical wards (27.5%) in the present study. The samples yielding Staphylococci, on culture, their clinical diagnosis and the wards admitting the patients show a positive correlation; standing to reason.

Very often risk factors may predict patient outcome and survival. In the present study, prolonged hospital stay of more than 5 days was an important risk factor (39.7%), as also Diabetes mellitus (46.4%). A longer stay in the hospital has been a major factor contributing to Nosocomial infections, especially when there are associated co morbidities such as diabetes mellitus.

CONCLUSION

Staphylococcal infections are a common occurrence amongst hospitalized patients and a cause of concern in the present multidrug resistant era. It is essential to conduct a regular surveillance to keep abreast with this causative agent, its prevalence and antibiogram pattern. This will serve as a guide to the physician to choose antibiotics, if needed to be given before the culture result is available.

Tables

TABLE 1: STAPHYLOCOCCI BASED ON COAGULASE TEST AND SENSITIVITY TO METHICILLIN (n=639)

	Staphylococcus aureus	CONS
Methicillin sensitive	197(53.5%)	85 (31.4%)
Methicillin resistant	171(46.5%)	186 (68.6%)
Total	368(57.6%)	271 (42.4%)

TABLE 2: ANTIMICROBIAL SENSITIVITY PATTERN OF STAPHYLOCOCCUS AUREUS AND CONS (PERCENTAGE)

Antibiotic	S. aureus	CONS
Penicillin	27.2	31.4
Ampicillin	36.1	31.4
Amoxycillin	45.4	47.2
Azithromycin	45.4	47.2
Trimethoprim + Sulphamethoxazole	72.6	78.6
Chloramphenicol	67.9	68.3
Ciprofloxacin	67.9	68.3
Levofloxacin	67.9	68.3
Gentamicin	54.3	52.4
Doxycycline	72.6	68.3
Clindamycin	72.6	78.6
Teichoplanin	72.6	78.6
Linezolid	90.8	89.3
Cefoxitin	53.5	31.4
Vancomycin	100	100

TABLE 3: AGE AND SEX DISTRIBUTION OF SUBJECTS UNDER STUDY

Age in years	Male		Female		Total	
	No.	%	No.	%	No.	%
0-10	21	61.8	13	38.2	34	5.4
11-20	11	57.9	8	42.1	19	2.9
21-30	86	60.1	57	39.9	143	22.4
31-40	130	53.7	112	46.3	242	37.9
41-50	95	60.5	62	39.5	157	24.6
51-60	22	57.8	16	42.2	38	5.9
> 61	3	50	3	50	6	0.9
Total	368	57.6	271	42.4	639	100

Male : Female Ratio = 1.4:1

TABLE 4: TYPE OF SAMPLES YIELDING STAPHYLOCOCCI

Sample	Number	Percentage
Pus	179	28.1
Slough	48	7.5
Swab	194	30.3
Cystic fluid	8	1.2
Tissue	13	2.1
Curettings	1	0.2
Sputum	12	1.9
Endotracheal aspirate	6	0.9
Endotracheal tube	2	0.3
Urine	43	6.7
Blood	107	16.8
Body fluids	8	1.2
CSF	6	0.9
Jugular catheter	12	1.9
Total	639	100

TABLE 5: CLINICAL DIAGNOSIS OF PATIENTS YIELDING STAPHYLOCOCCUS

Clinical Condition	Number	Percentage
Skin / soft tissue infection	383	59.9
Trauma associated	56	8.8
Osteomyelitis	4	0.6
Ventilator Associated Pneumonia	18	2.8
Bacteremia	84	13.2
Urinary Tract Infection	37	5.9
Chronic renal disease	6	0.9
No specific diagnosis	51	7.9
Total	639	100

TABLE 6: WARD / UNIT WISE DISTRIBUTION OF SUBJECTS UNDER STUDY

Ward / Unit	Number	Percentage
Surgical wards	153	27.5
Burns unit	16	2.9
Orthopedic wards	25	4.5
Gyaenecology wards	62	11.1
ENT ward	25	4.5
ICU	18	3.2
Urology ward	13	2.3
Medical wards	101	18.1
Paediatric wards	59	10.6
Skin wards	58	10.5
Pulmonary Medicine wards	27	4.8
Total	557	100

TABLE 7:RISK FACTORS ASSOCIATED WITH STAPHYLOCOCCAL INFECTIONS (n=639)

Clinical Condition	Number	Percentage
Trauma	56	8.8
Hospital stay of more than 5 days	254	39.7
Prolonged antibiotic use	109	17.1
Treatment with steroids	25	3.9
Use of gastric acid suppressants	18	2.8
Surgery undertaken	46	7.2
ICU stay	18	2.8
Presence of urinary catheter	21	3.3
Diabetes mellitus	297	46.4
Alcohol abuse	105	16.4
History of smoking	112	17.5

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