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Speciation and Resistotyping of Coagulase Negative Staphylococci in Clinical Isolates in Kerala Medical College, Palakkad

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Abstract

Introduction: Coagulase negative staphylococci are important causative agents of 10% of pyogenic infections in hospitals, which include a range of infections like surgical wound sepsis, bacteremia, native valve endocarditis (NVE) and prosthetic valve endocarditis, osteomylitis, pyoarthritis, peritonitis, mediastinitis, prostatitis, infection of vascular grafts and pacemakers. *Materials and Methods:* 105 samples are collected from infected post operative cases, infected burns, infected wounds from traumotology unit, diabetic foot, gangrene, nonhealing ulcers, pyoderma, and impetigo, patients with intravenous cannulae. *Results:* of 105 samples tested 50 (47.61%) of CNS are isolated, Out of 50 isolates of Coagulase negative staphylococci 24 (48%) isolates were identified as S.epidermidis. Out of 34 community isolates, 13 (38.23%) were sensitive to Penicillin and. 11(61.76%)were resistant 13 (75.47%) were sensitive to Oxacillin and 3(13.23%) were resistant. *Conclusion:* In the present study CNS was the most predominant organism (105/50; 47.61%). Most of CNS isolates were from the hospital infections (68%). Coagulase negative Staphylococci have been increasingly gaining importance in hospital infections, compared to E. coli, Klebsiella, MRSA and Pseudomonas. Majority of the isolates were from IV catheters (76.19%), stressing the need for more aseptic precautions in ICU settings.

Keywords: I.V.; MRSA; CNS.

Introduction

The importance of coagulase negative Staphylococci (CNS) in causing human infections is well documented (Pulverer and Pillich, 1971) [1]. Coagulase negative staphylococci are important causative agents of 10% of pyogenic infections in hospitals, which include a range of infections like surgical wound sepsis, bacteremia, native valve endocarditis (NVE) and prosthetic valve endocarditis, osteomylitis, pyoarthritis, peritonitis, mediastinitis, prostatitis, infection of vascular grafts and pacemakers, infective intravascular catheters, cerebrospinal fluid shunts, orthopedic devices and urinary tract infections.

Normally commensals on the skin and mucous membrane, coagulase negative staphylococci become opportunistic pathogens in conditions of lowered resistance in the local area. Establishment of causal relationship is important in treatment. Repeated isolation of the same organism from the lesion establishes the etiological relationship.

Coagulase test is the arbitrary test to divide the staphylococci into two groups. Group one consists of coagulase positive staphylococci, which are the established pathogens. Group two consists of

coagulase negative staphylococci, which are commensals and opportunistic pathogens.

Till a few decades ago, infections caused by these organisms were restricted to skin/wound infections and UTI in sexually active females. Coincident with remarkable developments in disease diagnosis and treatment, as well as the increased incidence of device associated infections caused by coagulase negative staphylococci, the importance of these organisms in human infection has remarkably increased in the recent times. As this organism occupies more than 10% of hospital infections, antibiotic sensitivity pattern also showed a change and increased degree of antibiotic resistance is being documented. There are a number of species of coagulase negative staphylococci, but only a few of them are predominant in causing opportunistic infections.

Coagulase negative staphylococci isolated from various specimens received from these hospitals are speciated and their antibiogram is studied. Since most of the infections caused by coagulase negative staphylococci are hospital associated, it is extremely relevant to study the resistance pattern so that it will serve as a useful guide to the health care providers. In a recent study (Banerjee et al. 1991) [2] resistance to betalactam antibiotics has been reported in coagulase negative staphylococci as well. Hence the study is attempted to speciate the clinical isolates of coagulase negative staphylococci and study their antibiogram with special reference to methicillin and vancomycin resistance.

Material and Methods

Sample Collection

The study was conducted in Kerala medical college & Hospital, Pallkad,Kerala The samples were collected from outpatients and inpatients of surgical, medical, orthopedic wards, 105 samples are collected from infected post operative cases, infected burns, infected wounds from traumotology unit, diabetic foot, gangrene, nonhealing ulcers, pyoderma, and impetigo, patients with intravenous cannulae were chosen as subjects of study after obtaining approval from the institutional Ethics committee and written informed consent was taken from the patients. The co morbid, immunosupressed patients, Patients with Diabetes mellitus patients with Malnutrition and on Steroid therapy, patients with Hypoprotinemia, patients with Malignancies and on Anti-malignancy drugs were completely excluded. Serous, serosanguinous or purulent discharge from the ulcers or wounds is collected with sterile swabs from the base of the lesions, without touching the surrounding area of skin. In case of spreading lesions of skin and subcutaneous tissue (such as progressive gangrene) the material is collected from the active margins of the lesions, rather than from central portion. When the exudate was minimal, gentle pressure was applied at the base of the lesion and the expressed discharge was collected with the swab. Care was taken to avoid topical application of any antibiotics, at least 24hrs before collection of the sample. Two swabs were collected from each patient, one for making smears and another for culture. Swabs sterilized by autoclaving was used to collect specimens in preference to swabs sterilized by hot air oven .

The samples were processed as per the standard reference procedures (Koneman 2006) [3] Gram positive cluster forming staphylococci which are catalase positive oxidase negative bacitracin resistant furozolidone sensitive and fermentative by the OF test are identified as staphylococcal the staphylococci strains were subjected to slide and tube coagulase test and those strains, which are negative by both methods are identified as coagulase negative staphylococci.

As no single table in the standard references was completely comprehensive to identify most of the common species, a table was prepared using the standard reference texts and journals. This table helped in the identification of all the species of CNS isolated .

The following biochemical tests were used.

1. Ornithine decarboxylase
2. Urease
3. Novobiocin susceptibility
4. Polymyxin B
5. Trehalose fermentation
6. Mannitol fermentation
7. Lactose fermentation
8. Voges proskauer

Antibiogram of isolates was performed using Kirby Bayer method (Clinical and laboratory standards institute CLSI guidelines). The antibiotic discs used were

Amoxicillin 30ug

Penicillin 10 units

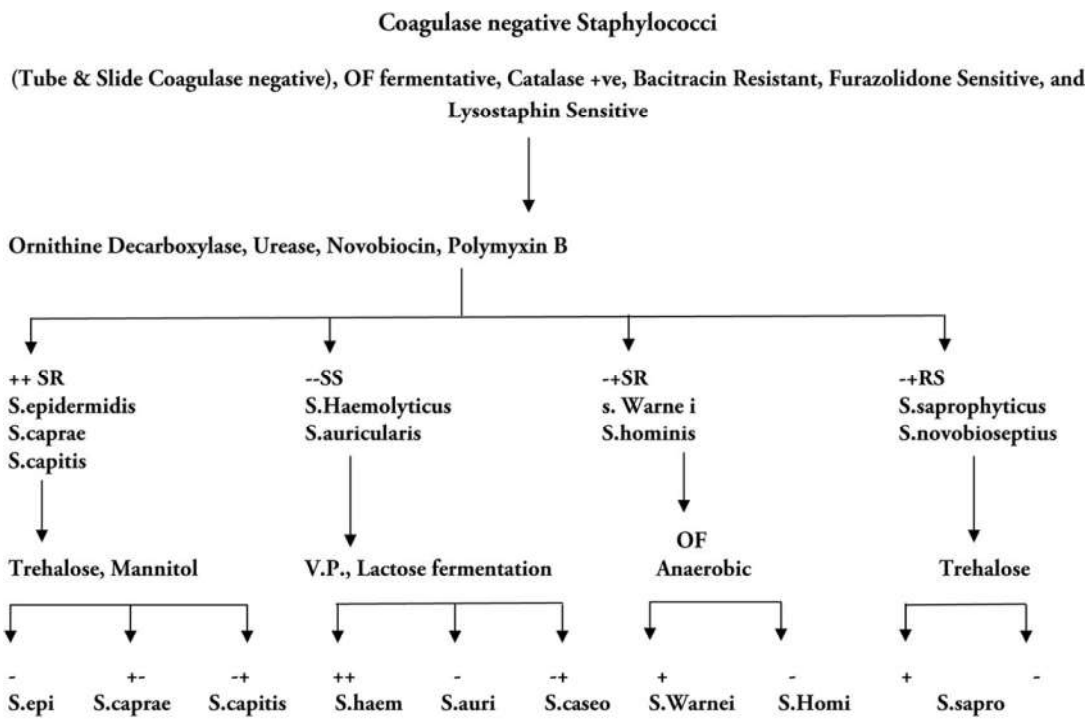
Oxacillin 1 mcg

Ciprofloxacin 5 mcg

Cotrimoxazole 25 mcg

Vancomycin 30 mcg

Results are tabulated



(Honeman 2006. Forbes 2007 R.Goyal 2006)

Results

Table 1 showing number and percentage of CNS isolates in the present study out of 105 samples tested 50 (47.61%) of CNS are isolated

Table 2 shows Speciation of Coagulase negative staphylococci isolates. Out of 50 isolates of Coagulase negative staphylococci 24 (48%) isolates were identified as S.epidermidis. 10 (20%) were identified as S.saprophyticus. 8(15%) were identified as S.haemolyticus. 7 (14%) were identified as S.hominis. 1 (3%) were identified as S caprae.

Table 3 showing distribution of hospital & community isolates of Coagulase negative staphylococci. Out of 50 samples, hospital isolates are 34 (68%), community isolates of Coagulase negative staphylococci are 16 (32%).

Table 4 shows isolates of Coagulase negative staphylococci from various sources. Out of 105 samples processed, 50 Coagulase negative staphylococci have been isolated, of which 21 were from cannulae and 16 (76.19%) Coagulase negative staphylococci were isolated. Out of 34 wound samples processed 19 (55.88%) were Coagulase negative staphylococci. Out of 27 urine samples processed 7 (27%) were Coagulase negative staphylococci. Out of 19 blood samples processed 7 (35.89%) were Coagulase negative staphylococci . Out of 3 samples of CSF only zero Coagulase negative staphylococcus isolated.

Table 1: Number and percentage of Coagulase negative staphylococci isolates in the present study

Total number of test Samples	Coagulase Negative Staphylococci	
	Number	Percentage
105	50	47.61

Table 2: Speciation of Coagulase negative staphylococci isolates

S. No.	Name of the Species	Number	Percentage
1.	S. epidermidis	24	48
2.	S. saprophyticus	10	20
3.	S. haemolyticus	8	15
4.	S. hominis	7	14
5.	S. caprae	1	3

Table 5 shows Sex wise distribution of Coagulase negative staphylococci isolates. 26(51%) of isolates were from males and 24 (49%) were from females.

Table 6 shows Age wise distribution of Coagulase negative staphylococci isolates. 4 (8%) of Coagulase negative staphylococci were seen in age group of 0-15 years. 8 (15%) of Coagulase negative staphylococci were seen in age group of 16-40 years. 39 (77%) of Coagulase negative staphylococci were seen in age group of more than 40 years.

Table 7 showing Antibiogram of hospital isolates of Coagulase negative staphylococci under study.

Out of 34 community isolates, 13 (38.23%) were sensitive to Penicillin and 11 (61.76%) were resistant.

Table 3: Distribution of hospital and community isolates of Coagulase negative staphylococci

S. No	Nature of isolates	Number	Percentage
1	Hospital	34	68
2	Community	16	32

Table 4: Isolates of Coagulase negative staphylococci from various sources

S. No	Sample	Number of samples processed	Number of CNS isolates	Percentage
1	IV catheter	21	16	76.19
2	Wound	34	19	55.88
3	Urine	27	7	27
4	Blood	19	7	35
5	CSF	3	0	0

Table 5: Sex wise distribution of Coagulase negative staphylococci isolates

S. No	Sex	Number of isolates	Percentage
1.	Male	26	51
2.	Female	24	49

Table 6: Age wise distribution of Coagulase negative staphylococci isolates

S. No	Age group	Number of CNS isolates	Percentage
1	0-15	4	8
2	16-40	8	15
3	> 40	39	77

Table 7: Antibiogram of hospital isolates of Coagulase negative staphylococci under study

S. No	Antibiotic	Resistant		Sensitive	
		Number	Percentage	Number	Percentage
1	Penicillin	11	61.76	7	38.23
2	Oxacillin	3	13.23	13	75.47
3	Ciprofloxacin	12	70.58	05	29.41
4	Vancomycin	4	23.52	13	76.47
5	Co trimoxazole	15	86.76	2	13.23
6	Amoxycillin	14	82.35	3	17.64

Table 8: Antibiogram of community isolates of Coagulase negative staphylococci under study

S. No.	Antibiotic	Resistant		Sensitive	
		Number	Percentage	Number	Percentage
1	Penicillin	5	34.37	10	65.62
2	Oxacillin	1	9.37	15	90.62
3	Ciprofloxacin	7	30.62	9	59.37
4	Vancomycin	8	46.87	5	53.13
5	Co trimoxazole	6	18.75	13	81.25
6	Amoxycillin	14	43.75	18	56.25

13 (75.47%) were sensitive to Oxacillin and 3 (13.23%) were resistant. (29.41%) were sensitive to Ciprofloxacin and 12 (70.58%) were resistant. 13 (76.47%) were sensitive to Vancomycin and 4 (23.52%) were resistant. 2 (13.23%) were sensitive to Cotrimoxazole and 15 (86.76%) were resistant. 3 (17.64%) were sensitive to Amoxycillin and 14 (82.35%) were resistant

Table 8 showing Antibiogram of community isolates of Coagulase negative staphylococci under study.

Out of 32 community isolates, 21(65.62%) were sensitive to Penicillin and 11 (34.37%) were resistant.

29 (90.62%) were sensitive to Oxacillin and 3 (9.37%) were resistant. 19 (59.37%) were sensitive to Ciprofloxacin and 13 (30.62%) were resistant. 17 (53.13%) were sensitive to Vancomycin and 5 (46.87%) were resistant. 26 (81.25%) were sensitive to Cotrimoxazole and 6 (18.75) were resistant. 18 (56.25%) were sensitive to Amoxycillin and 14 (43.75%) were resistant.

Table 9 shows Frequency of clinically significant Coagulase negative staphylococci under study.

Among total of 50 isolates of Coagulase negative staphylococci 24 identified as S. epidermidis, among which 9 are from IV cannulae, 6 are from blood, 4 each from urine & wounds and only one from CSF. Among the 10 isolates of S. saprophyticus, 5 are from IV cannulae, 4 from wound and one from urine. Among 7 isolates of S. haemolyticus, 6 are from wound, 1 from urine and zero from IV cannula.

Among 7 isolates of S. hominis, 5 are from wound, 1 each from blood and urine and one from IV cannula. Among 1 isolates of S. caprae, 1 are from wound and one from urine.

Table 9: Frequency of clinically significant Coagulase negative staphylococci under study

S. No	Name of the species	Total number	Wound	Catheter	Blood	CSF	Urine
1.	S.epidermidis	24	4	9	6	0	4
2.	S.saprophyticus	10	4	5	-	-	0
3.	S.haemolyticus	7	6	0	-	-	1
4.	S.hominis	7	5	0	1	-	1
5.	S caprae	1	1	-	-	-	-

Discussion

The clinical significance of CNS continues to increase as recent advances in medical practice lead to more invasive procedures, using introduction of synthetic material in to the body. The most vulnerable group to infection by CNS are hospitalized patients, especially those who are premature, very young or old and those who are immunocompromised and/or suffering from chronic debilitating illness or malignancy. Thanks to the progress in medical research, we are having more number of immunocompromised people, who can be managed for longer periods. All these groups are highly vulnerable to infections by CNS. Probably the only exception is young sexually active females who suffer from urinary tract infection due to S saprophyticus.

Since CNS is a commensal found on human body, establishment of causal; relationship to clinical disease is a serious challenge to the microbiology laboratory. If only adequate care is taken for accurate specimen collection and care taken to ensure the quality of the specimen, the challenge can be minimized. If the same isolate is obtained repeatedly from the same sample collected again and again, the etiological relationship becomes stronger. It can be further strengthened by genotyping of the isolates. However genotyping is not accessible to most of the microbiology laboratories. In the present study (Table 1) 50 CNS isolates were obtained by processing 105 clinical samples (47.61%) 68% were hospital isolates (Table 3), these results indicate the prominent place occupied by CNS in infections and more so in the hospital infections. The most predominant organisms causing hospital infection in the present times are E.Coli (Raksha et al 2003) [4], 102 Klebsiella (Casewell & Philips 1981) [5] 13, Pseudomonas and MRSA .The gradual increase of the importance of CNS in the recent times envisages the future place of CNS among microorganisms causing hospital infections. It need not be a surprise if it occupies the first place in the next decade to come.

The percentage isolation of CNS from clinical samples is not available in similar studies Show et al 2005, 112 have collected 205 swabs from the various places in the hospital and from healthy hospital staff. They obtained a percentage of 31.7% surprisingly all the staphylococcal isolates in their study were CNS. This study represents the magnitude of the hospital source from which infection can be transmitted to vulnerable patients through various invasive

procedures, if proper care and aseptic precautions are not taken.

Among the isolates in the present study 32% (Table 4) were from IV catheters Infections associated with intravascular devises is the present day problem, especially in intensive care units. As the procedure of IV cannulation is always performed as an emergency, there is often inadequate care for asepsis more over patients admitted inadequate care for asepsis. More over the patient admitted into the ICU is often severely ill and Immunocompromised. Due to this reason the coagulase negative staphylococci colonizing on the skin have an easy access to the device inside the body. The organisms can easily adhere to the device with the help of polysaccharide adhesin and produce slime with the help of which can survive on the device. Catheter associated bacterimia is common in the hospitalized patients. In the study of Goel et al 2006, 10.7% of the isolates were found from the catheter. The study of Goel is dated back to 2006 and the present study is under taken almost 2 years later, the high percentage of catheter isolates can be due to the generalized increase in the IV cannulation procedures, either for intravenous alimentation or for emergency parenteral infusion of drugs.

Maximum numbers of CNS isolates in the present study are from the wounds, 55.88% (Table 4). All samples collected from wounds are from inpatients and hence these isolates can be demarcated as hospital strains in the study of Goel et al 2006 38.2% of isolates were from wounds whereas(Gaikwad and Deodher1983) [6] obtained 76, 92% of their strains from wound exudates. Surgical sepsis is one of the commonest infections encountered in the hospital. The percentage incidence of surgical sepsis in any hospital is an indicator of quality of Medicare in the hospital, lesser the sepsis the better is the quality. Ideally a good hospital should have a percentage of less than four of surgical sepsis (Hospital infections control practices advisory committee 1999).

In the present study 14% of the CNS isolates are from blood (Table 4) Goel et al. (2006) obtained 14.7% of CNS isolates from blood, and (Gaikward and Deodhar 1983) [6] obtained 11.74% from blood. The overall rate of nosocomial blood stream infection has drastically increased since the past 2 decades due to reasons explained earlier (Forbes et al 2007) [7]. The incidence of blood stream infections with CNS is also on the rise due to spread of the organism from the IV cannula into the blood. If it is a case of burns or bed sores the associated blood stream the infections are all the more risky because of transmission of hospital residents through the colonized site. As very well understood hospital residents are multidrug resistant. Urinary isolates of CNS occupied 15% in the present study (Table 4) Goel et al 2006 have reported 28.4% of isolates from urine, and (Gaikwad and Deodhar 1983) [6], only 1 strain of CNS from urine. Urinary tract infections caused by CNS are very often associated with urinary catheterization . In the community E coli is the commonest urinary pathogen, while in the hospital CNS occupy the first place. The number of patients in hospitals and nursing homes with long term indwelling catheters continue to increase. With catheterization the colonizing populations of urine in the urethra get access into the bladder. The organisms rapidly colonize on the urinary catheter and produce cystitis. The infection develops more rapidly if the patient is non ambulatory. Diabetes mellitus is a predisposing factors and diabetic patients are more prone for developing compromised urinary system. Hospitalized diabetic patients are catheterized more often and are at higher risk of UTI with CNS (Mahon and Manusilis 2000) [8].

Only one isolate in the present study in the CSF (Table 4). CNS enters the central nervous system through intrathecal procedures like lumbar puncture. Some times when the resistance of the host is severely compromised like in the advance stage of HIV infection or late stage of terminal illness with nosocomial bacterimia, patients with corticosteroid therapy or chemotherapy are at a higher risk. The predominant species of CNS in present study is S epidermidis (Table 2), Of the 48 strains of S epidermidis isolated 19 were from catheter 12 from blood 8 each from urine and wounds and one from CSF (Table 9). S epidermidis is the most commonly encountered species among the CNS. Its prevalence as nosocomial pathogen is very much related to medical procedures and practices than the capacity of the organism to establish infection (Hebert et al 1988, Bailey and Scott 2000) [9] (Carloos et al 1991) [10] identified a endemic strain of S epidermidis in the hospital producing bacterimia in the neonatal intensive care unit. S epidermidis is a notorious slime producer and easily establishes biofilm on polymers within the biofilm the organism can limit the effectiveness of antibiotic therapy and multiplies further as reported by (Shoba et al 2005) [11] Staphylococcus epidermidis is prevalent in 49.23% of hospital sites including the skin of the health care providers. 14% of these strains are oxacillin resistant, thus S epidermidis can be termed as an important hospital pathogen and hospital infection control programs should include eradication of this organism from the hospital sites.

20% of CNS Isolates are identified as S

saprophyticus (Table 4,9). This organism unlike S epidermidis is more a member of the community. Urinary tract infections caused by Staphylococci in the community are mostly due to S saprophyticus. It is a common organism isolated from urine from community acquired urinary infections in young sexually active female. Establishment of S saprophyticus as pathogen requires repeated careful processing and quantitative urine cultures as the organism inhabits the normal urethra and perineal skin, it is likely to contaminate urine samples during collection.

The role of the microbiologist is crucial in this situation. In the present study 11% isolates of S saprophyticus are from the catheter, 8% from wounds and only 1% from urine. S saprophyticus like S epidermidis is also a normal flora of human skin and in addition it colonizes the mucosa of gentitourinary tract. Though it is an established cause of urinary tract infections, catheter related sepsis due to S saprophyticus is not well studied. S saprophyticus has high capacity to adhere and colonize on surfaces, but unlike S epidermidis it is a poor producer of slime (Kloos and Bannerman 1994) [12]. Hence, catheter colonization by S saprophyticus is not as dangerous as that with S epidermidis, since the former cannot produce a biofilm and cause bacterimia. S saprophyticus exhibits receptor mediated adherence to uroepithelial cells and production of urease by S saprophyticus helps in its survival in the urinary tract.

In the present study 15% of isolates are identified as S hemolyticus (Table 2) Among the 15 strains 11 are isolated from wound 3 from urine and 1 from IV cannulae (Table 9). S haemolyticus is also part of the human normal skin flora. It has been documented as a cause of nosocomial baterimia. wound and soft tissue infection, UTI, pediatric and neonatal bacterimias. Vancomycin resistance as been reported in this organism as well as multidrug resistance. The presence of multiple antibiotic resistant S hemolyticus in the hospital environment and transmission of resistant clones through the hands of health care workers havebeen documented by several investigators using molecular methods (Koneman 2006) [13] Compared to S epidermidis this organism colonizes in much fewer numbers and hence less commonly incorporated in clinical illness. The study of virulence factors in S hemolyticus has been futile thus it can be that the disease caused by this disease is milder.

S hominis isolates were 14% among the total CNS isolates in the present study (Table 4,9). Among the 14 strains 9 were from wound, 2 strains each from blood and urine and 1 from catheter. This species is a comensal in the skin of humans and has occasionally been isolated from infections as a low grade pathogen (Koneman 2006) [14]. Among the total CSF isolates it is infrequent and when it is isolated as a pathogen severity and extent of infection are less (Kloos and Bannerman 1994) [15]. However under antibiotic pressure it is known to develop resistant more easily and readily (Kloos and bannermann1994). Like many other coagulase-negative staphylococci, S. hominis may occasionally cause infection in patients whose immune system is compromised, for example by chemotherapy or predisposing illness.

S caprae strains occupied least important position 3% among the total CNS isolates in the present study (Table 2) among them 2 are from wound and 1 from urine (Table 9). S caprae is rarely cultured from clinical specimen when compared to S epidermidis it as been reported in association with bone and joint infection (Koneman 2006). Strains of S caprae isolated from humans known to contain a 5 gene Ica operon that coded for the gene products involved in biofilm formation. The gene products exhibit subtotal aminoacid identity with those of S epidermidis.

In the present study infections with CNS among males are more or less equal to that of females. There is no sexual predisposition (Table 6). The age group of more than 40 years had the highest incidence 44% CNS in present study (Table 7).

This is the age group which as most of the predisposing factors to CNS infections like lowered immune status, Diabetic Nephropathy, Hypertensive Nephropathy, malignancy, obstructive urinary tract diseases with frequent IV cannulation and urinary catheterization. Among the hospital isolates of CNS oxacillin resistance is 13.23%(Table 8), where as in community isolates it is much lower 9.37% (Table 9). Methicillin resistance among CNS clinical isolates were studied by Shoba et al 2005. They have reported 14% of methicillin resistance in hospital resident CNS flora. Similar studies have been reported by Vijayalakshmi et al (Shoba et al). Like in S. aureus methicillin resistance among strains of CNS is matter of serious concern.

Further studies are required to elaborate on multidrug resistance in hospital strains of CNS. The future microbiologists should aim at an efficient and patient team work to eradicate the hospital resident flora, more so the methicilline resistant flora. Vanocomycin resistance in the present study is 23.5% in hospital isolates of CNS and 18.75% in community isolates. Vancomycin is the drug of choice for treatment of methicillin resistant staphylococci and restricted and choicest use of this antibiotic can greatly reduce the risk of acquisition of resistance

by the organism. MIC of the clinical isolates for methiciline and vancomycin could not be studied for want of antibiotic in pure powder form in time.

Summary & Conclusions

1. In the present study CNS was the most predominant organism (105/50; 47.61%).
2. Most of CNS isolates were from the hospital infections (68%).
3. Coagulase negative Staphylococci have been increasingly gaining importance in hospital infections, compared to E. coli, Klebsiella, MRSA and Pseudomonas.
4. Majority of the isolates were from IV catheters (76.19%), stressing the need for more aseptic precautions in ICU settings.
5. Higher percentage of isolates from IV catheters points to increase in IV cannulation procedure, either by alimentation or by drug infusion.
6. Maximum numbers of CNS isolates were from wounds (38%).
7. Sizeable number (15%) CNS isolates are from urine samples. Improper precautions during catheterization and non ambulatory status of the patient contribute to this increase in UTI.
8. Considerable numbers of CNS isolates are from blood (14%). In case of burns or bed sores, the blood stream infections pose more threat as the organisms are usually multidrug resistant, being hospital resident.
9. Metabolic disorders like Diabetes mellitus compromise the urinary system predisposing to higher risk of UTI with CNS.
10. Immunosuppression either natural (HIV) or therapeutic (Steroids) can make patients more vulnerable to infections with CNS (Study with more number is required).
11. Most predominant species of CNS in this study is S. epidermidis, followed by S. saprophyticus.
12. Further studies with larger sample size are required to elaborate on multidrug resistance in hospital strains of CNS.

References

1. Pulverer, G., and J. Pillich. 1971. Pathogenic significance ofcoagulase-negative staphylococci, 1971. p.91-96. In M. Finland, W. Marget, and K. Bartmann (ed.), Bacterial infections: changes in their causative agents; trends and possible basis. Springer-1971.
2. Banerjee S.N.T.G Emori, D.H.Culver, R.P.Gayes W.R. Jarvis,T. Horan,J.R. Edwards J.S. Tolson,T. Henderson, W.J.Matrone and National nosocomial infection surveillance system 1991. Secular trends in nosocomial primary blood stream infections in united stats Am J. Med. 1991;91(Suppl.3B): 1980-1989; 865-895.
3. Koneman, Washington. winn. junior, Steph. Allen and Willium. Janda colour atlas and text book of Microbilogy. Ed., 2006;626-29.
4. Raksha R., Srinivasa H., Macaden R.S. Occurrence & Characterisation of Uropathogenic E. coli in urinary tract infections, Ind J of Medical Microbiology-2003 Oct:102-7.
5. Casewell and Philips, 1981 Casewell M.W., Philips I. Aspects of Plasmid mediated antibiotic resistance & epidemiology of Klebsiella spp. Am J Med 1981; 70:459-62.
6. Gaikwad SS, Deodhar LP. Study of coagulase-negative Staphylococci in clinical infections. J Postgrad Med 1983;29:162-4.
7. Forbes B.A., Sahm D.F, Weissfeld. A.S. Bailey & Scott's Diagnostic Microbiology Ed :12th, 2007;217:946.
8. Mohan V, Jindal N, Aggarwal P. Species distribution and antibiotic sensitivity pattern of coagulase negative staphylococci isolated from various clinical specimens. Indian J Med Microbiol 2002;20:45-6.
9. Hebert, G. A., R. C. Cooksey, N. C. Clark, B. C. Hill, W. R. Jarvis, and C. Thornsberry. 1988. Biotyping coagulase-negative staphylococci. J. Clin. Microbiol. 26:1950-1956.
10. Carlos, C. C., S. Ringertz, M. Rylander, P. Huovinen, and G. Faxelius. Nosocomial Staphylococcus epidermidis septicaemia among very low birth weight neonates in an intensive care unit. J. Hosp. Infect. 1991;19:201-207.
11. KL Shobha, PS Rao, J Thomas. Survey of Staphylococcus isolates among hospital personnel, environment and their antibiogram with special emphasis on methicillin resistance. Indian J Med Microbiol. 2005 Jul;23(3):186-8.
12. Kloos, W. E., K. H. Schleifer, and F. Gotz. 1991. The genus Staphylococcus, p. 1369 1420. In A. Balows, H. G. Truper, M. Dworkin, W. Harder, and K. H. Schleifer (ed.), The prokaryotes. Springer-Verlag, NewYork. 1992.
13. Kloos, W. E., and D. W. Lambe, Jr. 1991. Staphylococcus, p. 222-237. In A. Balows, W. J. Hausler, Jr., K. L. Herrmann, H. D. Isenberg, and H. J. Shadomy (ed.), Manual of clinical microbiology, 5th ed. American Society for Microbiology, Washington, D.C.
14. Kloos, W. E., and J. F. Wolfshohl. Identification of Staphylococcus species with the API Staph-Ident system. J. Clin. Microbiol. 1982;16:509-516.