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Research Article

The isolation pattern, species distribution and antibiotic susceptibility profile of coagulase negative Staphylococci: emerging opportunistic pathogens

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Abstract
Background: Coagulase negative staphylococci (CoNS), once considered as non-pathogenic commensal of skin and mucus membrane have emerged as important cause of health care associated infections (HCAI).
Objective: The present study was conducted with an aim to study isolation pattern, species distribution and antibiotic susceptibility profile of CoNS isolated from various clinical specimens.
Method: A total of 385 CoNS isolated various clinical specimens were included in the study. Kloos and Schleifer scheme was used for speciation of the isolates. The antibiotic susceptibility testing of the isolates was performed on Mueller Hinton agar by Kirby –Bauer disc diffusion method.
Results: *S. epidermidis* followed by *S. haemolyticus* and *S. saprophyticus* were the maximum isolated species of CoNS. Majority CoNS isolates were resistant to routinely used antibiotics. A total of 102 (29.3%) isolates were sensitive to methicillin.
Conclusion: Isolation of CoNS can't be overlooked as commensals nor dismissed as contaminants. *S. epidermidis, S. haemolyticus and S. saprophyticus* are most common species of CoNS implicated in human infections and often demonstrate low sensitivity to commonly used antibiotics. Therefore species identification and antibiotic sensitivity testing appears to be mandatory for individual assessment as no particular pattern can be predicted in any intricate situation caused by CoNS.
Key words: Antibiotic sensitivity, biochemical tests, coagulase negative Staphylococci, methicillin resistance

1. Introduction

Coagulase negative staphylococci (CoNS), once considered as non-pathogenic commensal of skin and mucus membrane have emerged as important cause of health care associated infections (HCAI). [1] It belongs to family Micrococcaceae and genus Staphylococcus. They are gram positive, cluster forming cocci.[2]

Factors like breach in natural mucocutaneous barrier, immunosuppression and presence of indwelling medical devices predispose to CoNS infections.[2, 3] CoNS bacteremia is common critically ill infants, patients receiving immunosuppressive therapy, bone marrow transplant recipients and patients with granulocytopenia. [4, 5] It is the 4th most common cause of septicemia in children with lymphoma and leukemia.[6]

At least half of all cases of HCAI are associated with medical devices. CoNS colonize and form biofilm over the surface of medical devices like prosthetic valve, hemodialysis catheter and central venous catheter.[7] Medical device related infections are potentially life threatening.

Although more than 31 species of CoNS have been recognized, but only few of these pose clinical problems. The most common species of CoNS implicated in human infections are *Staphylococcus epidermidis*, *Staphylococcus haemolyticus* and *Staphylococcus saprophyticus*.[8] However the role other species like *S. hominis, S. warneri, S. simulans, S. lugdunensis, S. schleiferi, S. saccharolyticus* and *S. cohnii* in human infections is recently known.[9]

The present study was conducted with an aim to study isolation pattern, species distribution and antibiotic susceptibility profile of CoNS isolated from various clinical specimens.

2. Materials and methods

The present study was conducted in the Department of Microbiology, Travancore Medical College, Kollam, Kerala. A total of 385 CoNS isolated various clinical specimens received in bacteriology section of the department for isolation and identification of pathogens were included in the study. CoNS isolated in mixed cultures were excluded from the study.

These isolates were subcultured on nutrient agar and subjected to battery of biochemical tests for speciation of CoNS. The biochemical tests were selected from Kloos and Schleifer scheme.[9] These included sugar fermentation test, phosphatase test, urease production, acetoin production, ornithine decarboxylation reaction, nitrate reduction and novobiocin and bacitracin sensitivity test

The antibiotic susceptibility testing of the isolates was performed on Mueller Hinton agar by Kirby –Bauer disc diffusion method. *Staphyloccus aureus* ATCC 25923 was used as control strain. For identification of methicillin resistance in the isolates, Mueller Hinton agar with 5% NaCl was used.

3. Results

The distribution of CoNS in different clinical specimens is shown in Figure.1 majority isolates were obtained from blood cultures (28%) followed by urine samples (21%). Figure 2 shows the species wise distribution of CoNS isolated from various clinical specimens. *S. epidermidis* (38.5%) followed by *S. haemolyticus* (28.4%) and *S. saprophyticus* (23.8%) were the maximum isolated species of CoNS. *S. cohnii* (1.1%) and *S. schleiferi* (0.2%) were the least isolated species of CoNS. The majority of isolates obtained from blood cultures were *S. epidermidis* and *S. haemolyticus*. Most of these blood cultures were received from neonatal intensive care unit (NICU). In urine cultures *S. epidermidis* and *S. saprophyticus* were the common isolates. *S. saprophyticus* was the common isolate in young women and *S. epidermidis* was common in patients with urinary catheters.

As shown in Table 1 maximum CoNS isolates were resistant to antibiotics like Penicillin G, cotrimaxazole, amoxicillin and erythromycin. A total of 102 (29.3%) isolates were sensitive to methicillin. Antibiotic resistance was more common in *S. epidermidis* as compared to other species of CoNS. In this study all isolates were sensitive to vancomycin.

Figure 1. Sample wise distribution of CoNS

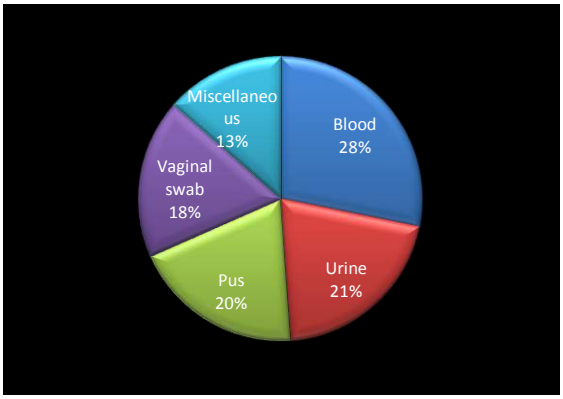
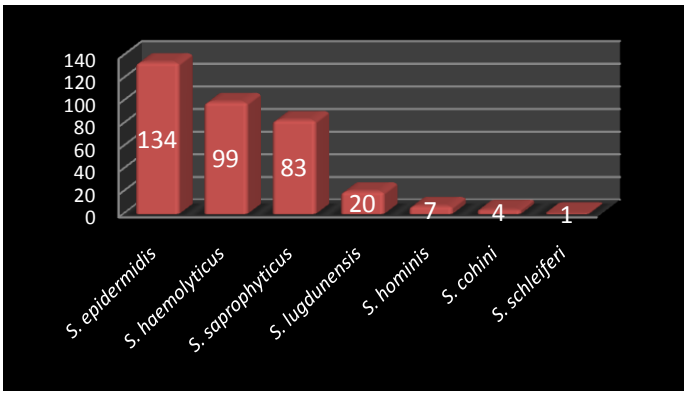


Figure 2. Species wise distribution of CoNS



[y] Miscellaneous specimens include catheter tips, drain, eye swab and ear swab.

Table.1 Antibiotic susceptibility profile of CoNS.

Sr. No	Antibiotic	No. sensitive isolates	Percentage
1	Penicillin G	67	19.2%
2	Amoxycillin	81	23.2%
3	Erythromycin	89	25.5%
4	Gentamycin	98	28.1%
5	Ciprofloxacin	101	29.1%
6	Cotrimaxazole	79	22.7%
7	Amikacin	145	41.6%
8	Ceftazidime	79	22.7%
9	Cephotaxime	91	26.1%
10	Cefepime	104	29.8%
11	Methicillin	102	29.3%
12	Vancomycin	348	100%

4. Discussion

In recent years infections caused by CoNS are increasingly reported.[10, 11] CoNS are now considered as one of the important etiological agents of health care associated and opportunistic infections. The increase can be attributed more to predisposing host factors like immunocompromised status, chronic illness, presence of foreign body and presence of one or other type of indwelling prosthetic medical devices rather than change in virulence of organism.[12]

In our study majority of CoNS were obtained from blood cultures and most of these blood cultures were from NICU patients. In the study of Roy *et al* CoNS were the third most common cause of bacteremia in neonates.[11] CoNS can cause life threatening infection in high risk neonates like with poor perinatal history, premature new born, neonates with invasive producers like umbilical arterial/ venous catheterization, endotracheal intubation, jugular or subclavian central alimentation catheter etc.[4]

S. epidermidis and *S. haemolyticus* were most common species of CoNS isolated from blood cultures. Our observation is in accordance to that of Low *et al*.[13] *S. epidermidis* is emerging as an important cause of morbidity and mortality in immunocompromised patients. It is most common cause of septicemia in leukemia and lymphoma patients.[14]

CoNS are the most common bacteria colonizing skin and mucous membrane and can contaminate the blood culture if proper aseptic techniques are not followed while collection of blood. The clinical isolate of CoNS are considered as significant pathogen when it is isolated in pure culture or repeatedly isolated.

CoNS are well known cause of urinary tract infection (UTI).[15] In our study *S. epidermidis* and *S. saprophyticus* were the common isolates obtained from urine samples. Our observation is similar to that of Kumari *et al*,[10] Nicolle *et al* [16] and Leighton *et al.* [17]

S. saprophyticus is a true urinary pathogen causing upper and lower urinary tract infection. It is the most common causative organism of cystitis in young sexually active women.[18] Urease production is most important virulence factor contributing to pathogenicity of *S. saprophyticus*.[19] *S. saprophyticus* also possess increased capacity of adherence to the uroepithelial cells. UTI due to *S. epidermidis* and other CoNS is usually catheter induced and it is more commonly seen in elderly patients with instrumentation or surgical intervention for urological abnormalities. [19]

CoNS may be recovered from variety of cutaneous lesions (cyst, carbuncles, and furuncles) both alone and along with pyogenic bacteria including *S. aureus* and β haemolytic Streptococci. The most commonly implicated species are *S. epidermidis, S. haemolyticus*, *S. lugdunensis* and *S. hominis*.[20]

CoNS are ubiquitous and may act as a reservoir for drug resistance gene. The widespread use of broad spectrum antibiotics in community and health care set ups has contributed to the drug resistance in *Staphylococcus* spp. In the present study majority of CoNS isolates demonstrated resistance to commonly used antimicrobial agents. Our observation is similar to that of Mitt *et al*. [21] In our study *S. epidermidis* demonstrated less sensitivity to antimicrobial agents as compared to other species. Multidrug resistance in *S. epidermidis* has strong association between prolong hospitalization especially in surgical ICU and parenteral hyperalimentation.[22]

In our study only 29.3% of CoNS isolates were sensitive to methicillin. The methicillin resistance in *S. aureus* was first reported in 1961, at that time CoNS was considered as commensal with less or no clinical significance hence for a long period of time there was no information about methicillin resistance in CoNS.[23] Ohman *et al* reported methicillin resistance in 70-80% of CoNS isolates.[5] All isolates of CoNS were sensitive to vancomycin which is in accordance to the observation of Goyal *et al*.[3]

5. Conclusion

Coagulase negative Staphylococci have emerged as important cause of opportunistic and health care associated infections. CoNS can't be overlooked as commensals nor dismissed as contaminants. *S. epidermidis, S. haemolyticus and S. saprophyticus* are most common species of CoNS implicated in human infections and often demonstrate low sensitivity to commonly used antibiotics. Therefore species identification and antibiotic sensitivity testing appears to be mandatory for individual assessment as no particular pattern can be predicted in any intricate situation caused by CoNS.

References

1. Devenport DS, Massanari RM, Pfaller MA. Usefulness of test for slime production as a marker for clinically significant infections with Coagulase negative Staphylococci. *J Infect dis* 1986:153:332-40.
2. Karl HS. Gram positive cocci. In: Bergey's Manual of Systemic Bacteriology. Vol. 2, 1986; page no. 999-1035.
3. Goyal R, Singh NP, Kumar A. Simple and economical method for speciation and resistotyping of clinically significant CoNS. *Indian J Med Microbiol* 2006; 24:201-4.
4. Baumgart S, Hall SE, Campose J. Sepsis with Coagulase Negative Staphylococci in critically ill new born. *Am J Dis Child* 1983: 137:461-3.
5. Ohman CA, Bodh L, Edlund C. Multiresistant CoNS disseminate frequently between intubated patients in multidisciplinary intensive care unit. *Critical Care* 2004; 8:42-7.
6. Friedman LE, Brown AE, Miller DR. *Staphylococcus epidermidis* septicemia in children with leukemia and lymphoma. *Am J Dis Child* 1984; 138:715-19.
7. Dismukes WE, Adlof WK, Mortifier JB. Prosthetic valve endocarditis. *Circulation* 1973; XLVHI: 365-77.
8. Leven M, Jansens H, Ursi D, Verhoeven J. Rapid detection of Methicillin resistance in CoNS by commercially available fluorescence test. *J Clin Microbiol* 1995; 33:2183-85.
9. Kloos WE, Schleifer KH. Simplified scheme for routine identification of human staphylococcus species. *J Clin Microbiol* 1975; 1:82-8.
10. Kumari N, Rai A, Jaiswal CP. Coagulase negative Staphylococci as causative agent of UTI-Prevalence and Resistance status in IGIMS, Patna. *Indian J Pathol Microbiol* 2001; 44:415-19.
11. Roy I, Jain A, Kumar M, Agarwal SK. Bacteriology of neonatal septicemia in a tertiary care hospital of North India. *Indian J Med Microbiol* 2002; 20:156-9.
12. Kristinsson CG, Hastings JCG, Spencer RC. The role of extracellular slime in opsonophagocytosis of *Staphylococcus epidermidis*. *J Med Microbiol* 1988; 27:207-31.
13. Low DE, Schmidt BK. An endemic strain of Staphylococcus haemolyticus colonizing and causing bacteremia in neonatal ICU patients. *Paediatrics* 1992; 89:696-700.
14. Freeman DJ, Falkiner FR, Keane CT. New method for detection of slime production by coagulase negative Staphylococci. *J Clin Pathol* 1989; 42:872-74.
15. Bailey RR. Significance of coagulase negative Staphylococci in urine. *J Infect Dis* 1973 127; 179-82.
16. Nicolle LE, Hoban SA, Harding GK. Characterization of coagulase negative Staphylococci from urinary tract specimen. *J Clin Microbiol* 1983; 92:267-71.
17. Leighton PM, Little JA. Identification of coagulase negative Staphylococci isolated from urinary tract infection. *Am J Clin Pathol* 1985; Jan:92-5.
18. Koneman EW, Allen SD, Janda WM, Schreckenberger PC. The gram positive cocci part I: Staphylococci and related organism In: Color Atlas and Textbook of Diagnostic Microbiology (5th Edition) Lippincott. 1997.
19. Mc Tagrat LA, Rigby RC, Elliott TSJ. The pathogenesis of urinary tract infections associated with *E. coli*, *Staphylococcus saprophyticus* and *S. epidermidis*. *J Med Microbiol* 1990; 32:135-41.
20. Akiyama K, Kanjaki H, Tada J. Coagulase negative Staphylococci isolated from various skin lesions. *J Dermatol* 1998; 25:563-68.
21. Mitt P, Adamson V, Loivukena K. Epidemiology of nosocomial blood stream infection in Estonia. *J Hosp Infect* 2009; 71:365-70.
22. Christensen GD, Alen LB, Parisi JT. Nosocomial septicemia due to multiple antibiotic resistance *Staphylococcus epidermidis*. *Int Med* 1982; 96:1-10.
23. Jesudasan MV, Anandraj Sw, Jagdeepan P. Incidence of methicillin resistant coagulase positive and coagulase negative Staphylococci in blood culture. *Indian J Med res* 1997; 105:155-57.