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ORIGINAL ARTICLE

Retrospective Analysis Of The Incidence Of Nosocomial Infections In The ICU - Associated Risk Factors And Microbiological Profile

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ABSTRACT:

Background

Nosocomial infections, also known as health care associated infections, have become an important public health issue worldwide. Nosocomial infections pose a critical threat to patients, especially in high-risk departments such as intensive care units.

Aim

A retrospective review of the incidence of nosocomial infections in the ICU of a tertiary care hospital in Salem from January 2009 to December 2009 was performed.

Results

Among the 5680 patients who were admitted, the incidence of the nosocomial infection rate was 16%. Urinary tract infections (29.5%) were the most common ones, followed by lower respiratory tract infections occurring in 28.1% of the patients and blood stream infections in 22.8% of the patients.

Klebsiella pneumoniae was the most commonly isolated pathogen (23.1%), followed by Pseudomonas aeruginosa (12.7%) and Escherichia coli (10.4%).

Conclusion

An increased duration of the time spent in the ICU and interventional procedures increase the risk of nosocomial infections.

Key words: nosocomial infections, ICU

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INTRODUCTION:

The rising incidence of antibiotic resistance among bacterial organisms is alarming worldwide, especially in developing countries like ours, where the indiscriminate use of antibiotics is common. Antimicrobial resistance has emerged as an important determinant of the outcome for patients in the intensive care units (ICUs). Nosocomial infections can lead to complications in 25-33% of the patients who are admitted in the ICU[1]. The recurrent problems with these nosocomially-acquired infections are the changes in the microbiological profile and the antibiotic sensitivity pattern of the pathogens which are isolated[2]. The documented phenomena include the emergence of extended betalactamase producing organisms, the tendency of fluroquinolones, both to select the resistant strains of major pathogens and to induce cross resistance among the different classes like beta lactam and vancomycin resistance in Enterococci and Coagulase negative Staphylococci[3]. In industrialized countries, nosocomial infections occur in 2-12% of the hospitalized patients, with the rates being upto 21% in ICUs [4].Nosocomial infections may result in an excess length of stay in the

hospital for upto 10 days and increase in the costs of hospitalization .[1],[5],[6]

Nosocomial pneumonia remains to be a major medical problem in critically ill patients. It occurs at a rate of 5 –10 cases per 1000 hospital admissions and increases by as much as 6 to 20 fold in patients requiring mechanical ventilation[6]. Mechanically ventilated patients have a higher incidence of pneumonia and mortality than non-ventilated patients, with aspiration as the major route of entry of the bacteria into the lower respiratory tract.

Urinary tract infection is the second most common infection which is encountered in clinical practice, accounting for 40% of all such infections [3]. Most patients with nosocomial UTI have had genitourinary manipulation and 80% develop after urethral catheterization [3],[7]. Studies on nosocomial infections in the ICU are only limited in India. Recently, we carried out a retrospective study to determine the current status of nosocomial infections at a tertiary hospital in Salem. All data on nosocomial infections from January 2009 to December 2009 were retrieved and reviewed. The incidence of nosocomial infections in the ICU, most frequently, isolated pathogens and their antimicrobial profiles, were investigated.

MATERIALS AND METHODS:

The study population consisted of all patients admitted to the intensive care unit (Medical, Surgical, Cardiac and Neurosurgical) from January 1 2009 to December 31 2009.

INCLUSION CRITERIA:

1. Hospital stay for more than 48 hours.
2. The recovery of clinically significant isolates after 48 hours of hospital stay from any of the following specimens submitted. -Sputum, endotracheal /tracheal swabs, urine, blood, CSF, pus, exudates/discharges from surgical sites and wound swabs.

EXCLUSION CRITERIA:

1. The initial isolates that are taken during the first 48 hours of hospitalization, that are known to be community acquired.
2. Succeeding isolates, similar to the initial organisms that were labeled as community acquired.

PROCEDURE:

All patients admitted in the different ICUs from January 2009 to December 2009 were recorded. Data on the date and site of infection, patient demographic information and the devices used were collected for each patient. Moreover, the date on the isolated pathogens and their antimicrobial susceptibility pattern were also collected. The laboratory isolates of ICU patients from any clinical specimen were monitored for the presence of organisms. Patients with positive isolates and those who were in the ICU for more than 48 hours were evaluated.

The CDC (Center for Disease Control and Prevention) definitions and guidelines were used to identify the nosocomial infections.[8] The major nosocomial infections including lower respiratory tract infections (LRTIs), urinary tract infections (UTIs), and blood stream infections (BSIs) were defined as follows:

1. LRTIs refer to lower respiratory tract infections other than pneumonia, i.e. bronchitis, tracheobronchitis, bronchiolitis and tracheitis without the evidence of pneumonia.
2. 2.UTIs refer to symptomatic urinary tract infections and
3. BSIs refer to laboratory confirmed blood stream infections. The detailed criteria to diagnose these nosocomial infections were followed as per the CDC guidelines on nosocomial definitions.

   Statistical analysis was performed by using SPSS software. Chi square test and Spearman's rank correlation coefficients were applied wherever applicable. For all analyses, a p value of less than 0.05 was considered to be significant.

OPERATIONAL DEFINITIONS OF TERMS:

Nosocomial infections- Infections that develop 48 hours after confinement. The clinical basis for NI can be any one of the following: new onset fever, new chest x-ray findings, leucocytosis/leucopaenia, purulent surgical wound discharge, new onset UTI and the deterioration of the vital signs. By using the CDC guidelines, patients with possible nosocomial infections were evaluated.

Clinically significant isolates-isolates which are responsible for the ongoing infection as supported by the history, clinical findings and other laboratory results.

Baseline isolates-Organisms isolated from any specimen which was submitted from the patients who were diagnosed to have nosocomial infections.

Co-infection-Presence of a second organism in the patients with baseline isolates.

[Table/Fig 1]: Diagnostic criteria for nosocomial infection

Serial no	Nosocomial infection	Clinical features	Laboratory features
1	UTI	1. fever 2. Lower abdominalpain 3. change in urinary characteristics	1. leucocytosis 2. Positive urine culture (10^5 cfu/mlof urine)
2	LRTI	1. fever 2. Pleuritic chest pain 3. decreased intensity of breath sounds 4. presence or increase in rales	1.Leucocytosis 2. sputum for Gram stain 3.Positive sputum culture Positive chest x-ray
3	BSI	1. unexplained fever with chills and rigor 2. pain, tenderness or purulent discharge at the site of insertion of IV access or CVP catheter	1.leucocytosis 2. Positive blood culture 3.Positive CVP/ catheter culture
4	Skin & soft tissue infections	1.Pain, swelling,tenderness/ inflammation and warmth of skin Purulent drainage from skin fever	Smear for Gram stain 2.Positive swab culture 3.Leucocytosis

RESULTS:

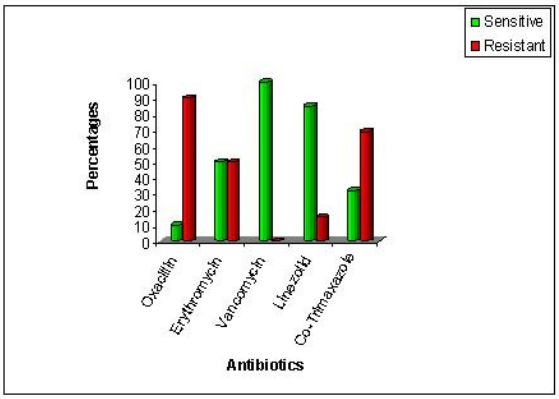
A total of 5680 patients were admitted in different ICUs from January 1 2009 to December 31 2009.Among these patients, 355 developed nosocomial infections with an incidence of 16%. The mean age was 47 and 77% of the patients were males. The mean length of hospital stay was 20.30+/- 13.14 days.

A majority of patients were admitted with neurological disorders (29.9%), followed by respiratory conditions (16.1%) and renal disorders (13.8%). Urinary tract infections and lower respiratory tract infections were the most common types of infections, occurring in 29.5% and 8.7% of the catheterized patients, followed by lower respiratory tract infections including bronchitis and bronchiolitis, occurring in 28.1% and17.7% of the patients who had mechanical ventilation or tracheostomy. 22.8% of the patients had blood stream infections and 4.5% of them were catheter associated. The nosocomial infections of surgical sites, skin and soft tissue were 8.2%. A majority of the patients with nosocomial infections had co-infection (24) or super infection (42) or both (31).

Klebsiella pneumoniae was the most commonly isolated pathogen (23.1%), followed by Pseudomonas aeruginosa (12.7%) and E.coli (10.4%). The other organisms which were isolated were Acinetobacter baumanni (9.9%), Candida spp (8.2%), S.aureus (3.9%), S.epidermidis (1.7%) and Enterococci (3.1%). In patients with urinary tract infections, E.coli was the most commonly isolated pathogen, followed by Candida species. In patients with lower respiratory tract infections, Klebsiella pneumoniae and Pseudomonas aeruginosa were the most commonly isolated pathogens, followed by Acinetobacter baumannii. Acinetobacter baumannii, S.aureus and S.epidermidis were the most commonly isolated pathogens in blood stream infections.

Very high resistance rates were seen with Gram-negative bacteria against third generation cephalosporins (77.2%), fourth generation cephalosporins (82.4%) and a combination of cephalosporins and beta lactamase inhibitors (37.9%). A fairly low level of resistance was seen with Ciprofloxacin (25%), Amikacin (16.7) and Augmentin (35%). All S.aureus isolates were susceptible to Vancomycin. A high rate of resistance was noted for Oxacillin (90%) and Co-trimaxazole (68.4%).[Table/Fig 2]

All patients with nosocomial infections were treated with empirical antimicrobial therapies or according to the susceptibility testing reports.
46 patients with nosocomial infections died in the ICU.



[Table/Fig 2]: Susceptibility pattern of S.aureus

DISCUSSION:

Nosocomial infections have become an important public health issue worldwide. The epidemiology of nosocomial infections, mainly in the ICUs, is less studied and is given less emphasis in the developing countries.[9] The relatively high incidence of nosocomial infections may be due to the excess length of hospital stay following high severity of illness, more intervention, no antibiotic policy and possibly poor adherence to aseptic techniques.[10]

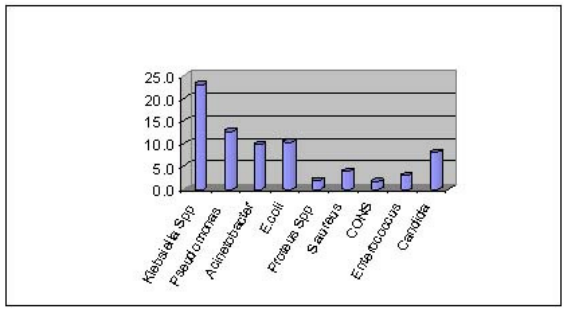
In the present study, the overall incidence of nosocomial infections in the ICU was 16%, which was lower than that observed in the ICUs of developing countries. However, the rate was comparable with those reported from many industrialized countries, where it ranged from 7.7% to 16.5%.[9]

The general distribution pattern of the nosocomial infections that emerged in our study showed UTIs (29.5%) to be the most common, followed by LRTIs (28.1%), BSIs (22.8%) and skin and soft tissue infections (11.26%). This is in concordance with the study performed by Mukherjee et al[11], which showed UTIs (45%) as the commonest nosocomial infections, followed by LRTIs (30%)and BSIs (16%). A study performed by Zoleta[1] et al showed LRTIs (66%) as the predominant infections, followed by UTIs (31%).

Our study population included 355 patients and a majority (n=272) were males. The higher rate of UTIs in the present study could be due to the male preponderance BPH in association with restricted mobility in the ICU and many of these patients had diabetes as a co morbid illness.

The study showed that 28.1% of the patients with nosocomial lower respiratory tract infections received mechanical ventilation (23.9%) or tracheostomy (10.1%). 8.7% of nosocomial urinary tract infections and 4.5% of blood stream infections were catheter associated.[Table/Fig 1] These findings indicate that the nosocomial infections are often associated with the use of invasive devices. Therefore, to effectively reduce nosocomial infections, the use of invasive devices should be minimized and specific disinfection precautions should be taken during the application of the device.[8]

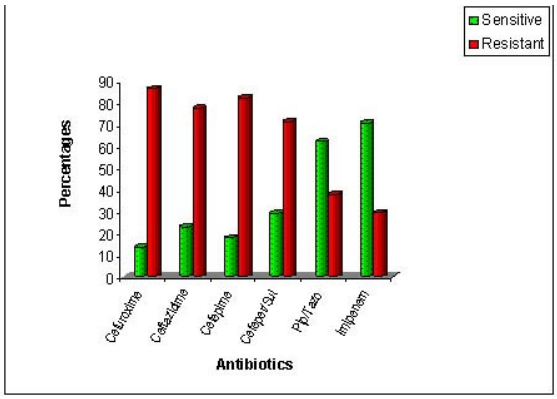
The most frequently encountered microorganisms were Klebsiella (23.1%), Pseudomonas aeruginosa (12.1%), Escherichia coli (10.4%) and Acinetobacter (9.9%). [Table/Fig 3]



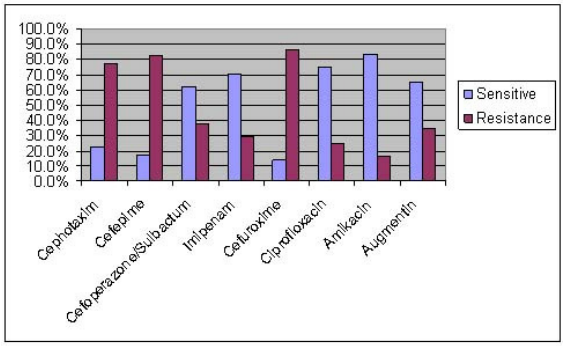
[Table/Fig 3]: Percentage of organisms isolated

The pathogen distribution of nosocomial infections in our study differs slightly from the findings of Mukherjee et al. We found Klebsiella spp to be the predominant pathogen which caused UTIs, but Mukherjee et al reported Pseudomonas aeruginosa to be the predominant cause of nosocomial UTIs. This difference could be explained by the difference in geographical locations, nutritional status and health care systems.

The rates of Gram negative isolates which were resistant to commonly used antibiotics ranged from 29.2% (imipenem) to 86.63% (II generation cephalosporins). [Table/Fig 4]



[Table/Fig 4]: Susceptibility pattern of gram negative isolates



[Table/Fig 4]: Susceptibility pattern of gram negative isolates

90% of the S.aureus species were Methicillin resistant and 15% were resistant to Linezolid. All isolates showed an in vitro susceptibility to Vancomycin

Since resistant organisms cause a high percentage of nosocomial infections, the antimicrobials used for the treatment of nosocomial infections must have a balanced and reliable spectrum of activity against these pathogens. Careful drug selection, coupled with surveillance and effective infection control procedures, may help in controlling pathogen resistance.

The present study has some limitations due to its retrospective nature. The data on the clinical consequences were not available for most cases, thus making it impossible to compare the clinical outcome of the patients with and without nosocomial infections. However, the present study showed that the length of stay in the hospital was significantly increased in patients with nosocomial infections, as compared to those without the infections.

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