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ORIGINAL ARTICLE

The Microbiological Profile of Nosocomial Infections in the Intensive Care Unit

SHALINI S, KRANTHI K, GOPALKRISHNA BHAT K*

ABSTRACT

Introduction: Nosocomial infections (NI) are those acquired in hospital settings. Each nosocomial infection adds 5-10 days to the affected patients' stay in the hospital and leads to extra expenditure, thus overburdening the already strained health economy. The rate of nosocomial infections ranges from 2.8% to 34.6% in various studies.

Materials and Methods: We conducted this study to estimate the rate of nosocomial infections in the Intensive care unit (ICU) of a tertiary care hospital from coastal Karnataka, South India. The patients who developed infections after 48 hours of admission to the ICU were included in the study. The specific site related investigations included blood cultures and cultures of CVP or intravenous catheter tips, urine and indwelling catheter tips, endotracheal tube tips, suction catheter tips and endotracheal secretions. 97 suspected cases of nosocomial infections were studied prospectively, which were identified as per the guidelines laid down by CDC.

Observations: The rate of nosocomial infections was 27. 4%. The rates of the urinary, respiratory and the intravascular catheter related infections were 55.52%, 35.78% and 11.52%, respectively. *Klebsiellapneumoniae* and *Staphylococcus aureus were* the most common isolates with maximum susceptibility to imipenem and vancomycin respectively. Environmental sampling and healthcare personnel screening showed the presence of these organisms as the local flora in our hospitals.

Conclusion: Infections in the ICU patients are important problems. Adherence to infection prevention protocols and the proper monitoring and the judicious use of antibiotics are important in preventing such infections.

Key words: Intensive care unit, nosocomial infection, nosocomial pathogen, drug resistance.

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Introduction

Nosocomial infections (NI) are responsible for morbidity and mortality in hospitalized patients. They also increase the cost of treatment and prolong hospitalization. The Centre for Disease Control and Prevention (CDC) defines the intensive care unit associated infections as those that occur after 48 hours of ICU admissions or within 48 hours after the transfer of the patients from the ICU [1].The rate of NIs varies from 2.8% to 34.6% among hospitalized patients [2].The rate of NIs in the ICU is rising, mainly because of the increasing use of invasive procedures which are performed in the ICU. The therapeutic interventions which are associated with infectious complications include indwelling catheters, sophisticated life support,

intravenous fluid therapy, prosthetic devices, immunosuppressive therapy, changes in the population at risk and the use of broad spectrum antibiotics leading to a spectrum of multidrug resistant pathogens, which contributed to the evolution of the problem of nosocomial infections [3]. We conducted this study to estimate the rate of nosocomial infections in the ICU in a teaching hospital, the risk factors associated with Nis and to detect the nosocomial bacteria and their antibiotic susceptibility patterns.

Materials and Methods

This study was conducted over a period of 18 months in the ICU of a tertiary care hospital from South India. (495 beds with 10 beds for medical ICU). The infections were considered to be intensive care unit associated, if they occurred within 48 hours of admission to the ICU. The following signs and symptoms were considered

1. Fever $\geq 38^0$C leukocytes $\geq$10,000/cu.mm
2. New infiltrates on chest x-ray, persistent tracheal aspirates or secretions
3. Turbid urine, suprapubic tenderness, dysuria and burning micturition were included in the study.

The known risk factors like the duration of ICU stay, mechanical ventilation and catheterization, the use of broad spectrum antibiotics and immunosuppressive drugs and the extremes of age and pre existing diseases were recorded.

The specific site related investigations included blood cultures and the cultures of intravenous catheter tips, urine and indwelling catheter tips, endotracheal tube tips, suction catheter tips and endotracheal secretions. The bacterial profiles and antimicrobial susceptibility were studied. The blood cultures and the sensitivity of the patients with suspected catheter sepsis were performed by a Semi automated Bac T /Alert system. The cultures of intravenous catheter tips (peripheral and central) were performed by the semi quantitative method of Maki et al [4] and bacterial growth with 15 or more colonies were considered as positive.

Purulent secretions from endotracheal tubes with a gram stain showing one or more types of bacteria and more than 25 neutrophils per low power field were selected for culture and growth. CFUs $\geq 10^7$ were considered as significant [5].

Urine samples were collected from the catheters and were cultured by a semi quantitative method by using a calibrated 4 mm diameter loop. The growth of bacteria in counts $\geq 10^5$ CFU/ml was considered as significant [6]. The susceptibility of the organisms to various antibiotics was tested by using a modified Kirby – Bauer disk diffusion method and the results were interpreted as per the CLSI guidelines. Methicillin resistance in *S.aureus* was detected by using the agar screen method (Mueller-Hinton agar supplemented with 4% NaCl and Oxacillin 6µg/ ml) [7].

Environmental sampling was done on a monthly basis from floors, walls, taps, disinfectants, ventilator tubings, suction pumps, oxygen catheters and from the swabs from the anterior nares of the doctors and nurses.

Results

During the 18 month study period, a total of 355 patients were admitted to the ICU, of which 27.4% (97/355) had clinically suspected nosocomial infections. A total of 324 samples were analyzed, which included 97 intravenous catheter tips and blood cultures each, 67 urine samples, 8 Foley's catheter tips, 49 ET aspirates and 6 ET tips. Significant growth was observed in 154 samples (47.5%) [Table/Fig 1].

[Table/Fig 1]: Microbiological profile of specimens from different sites of infection

Specimens	Number of specimens investigated	Number (%) of specimens culture positive
Blood culture	97	11 (11.52)
IV Catheter tips	97	51 (52.57)
Urine	67	55 (82.05)
Foley's catheter tips	8	2 (25)
Endotracheal secretion	49	33 (67.3)
ET tips	6/2	2 (33.3)
Total	324	154 (47.5)

Among the catheter related infections, UTI was the most common infection (55.52%), followed by Ventilator associated pulmonary infection (35.78%) and IV Catheter related infection (11.52%). Three patients had both pneumonia and probable catheter related bacteraemia.

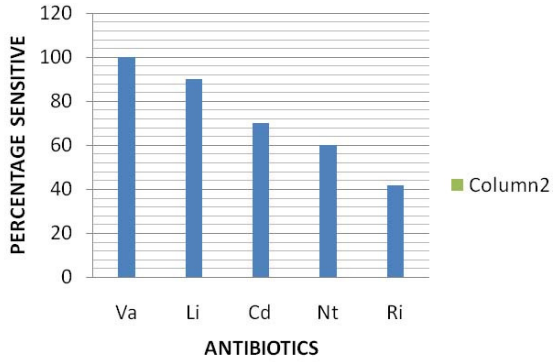
51 patients had some sort of altered immune status (HIV positive - 6, prolonged steroids - 3,

Diabetes mellitus -21, Chronic obstructive lung diseases- 9 , autoimmune diseases- 6 and broad spectrum antibiotics-5), which was statistically significant ($P \leq 0.05$) . 85. 65% of the patients developed nosocomial infections after 96 hours of stay in the ICU, thus proving that the longer the stay in ICU, the higher the risk of NIs ($P \leq 0.05$). *Klebsiella pneumoniae* was the most common pathogen (38.41%), followed by *Staphylococcus aureus* (23.37%) [Table/Fig 2].

[Table/Fig 2]: Organisms isolated from different sites

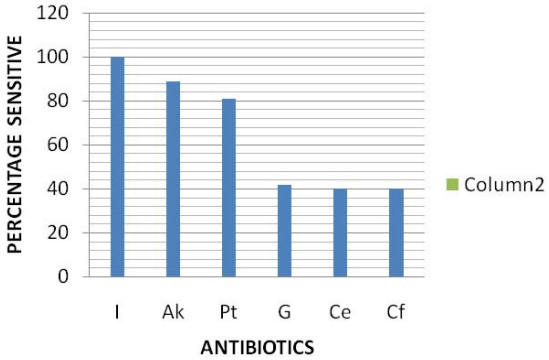
Organism	Blood & IVC	Urine & catheter	ET samples	Total	
				No	%
Acinetobacter spp	1	-	5	6	3.97
Candida albicans	4	5	1	10	6.62
Candida spp	15	1	-	10	10.59
Enterococcus fecalis	3	1	-	4	2.65
Escherichia coli	2	2	-	4	2.65
Klebsiella pneumoniae	4	36	18	58	38.41
Pseudomonas aeruginosa	4	9	6	19	12.58
Staphylococcus aureus	27	3	6	36	23.37
TOTAL	62	57	35	154	

We attempted to correlate the organisms which were isolated, with the antibiotic sensitivity pattern, so as to formulate antibiotic protocols. *K. pneumoniae* was most sensitive to Imipenem and Amikacin. 41% of *S.aureus* isolates were methicillin resistant *S. aureus* (MRSA) and these strains were found to be sensitive to Vancomycin. [Table/Fig 3] *K. pneumoniae* had the maximum sensitivity to Imipenem and Amikacin and *Pseudomonas aeruginosa* had the maximum sensitivity to Imipenem and Ceftazidime. [Table/Fig 4].



[Table/Fig 3]: Antibiotic Susceptibility pattern of nosocomial *S.aureus*

Exogenous sources from the environment: out of the 120 samples, we isolated 60 organisms (50%). *S.aureus* was the most commonest organism [28], followed by *K. pneumoniae* [10], *P.aeruginosa* [10] *Acinetobacter* spp [6] *S. epidermidis* [4] and *Enterococus* spp [2]



[Table/Fig 4]: Antibiotic susceptibility pattern of *K. pneumoniae*

Discussion

Health care – acquired infections have been associated with substantial morbidity,mortality and increased health care costs. An integrated infection control program can reduce the incidence of infection by as much as 30% and reduce the health care costs.

The high rate of nosocomial infections observed in the present study could be due to different clinical profiles of our patients and the absence of a powerful hospital acquired infection control program.

K. pneumoniae and *P. aeruginosa* were the commonest causes of respiratory infections and urinary tract infections. These findings were comparable to the observations of previous workers [8]. The environmental sampling of the ICU showed the predominance of *K.pneumoniae* and *P. aeruginosa* strains.
Catheter colonization and catheter related bacteraemia rates vary widely. The catheter colonization rate was found to vary from 5% to 61% and the catheter related bacteraemia rate was found to vary from 2% to 43% [9]. In the present study, the rates of catheter colonization and catheter related bacteraemia were 52. 57% and 11.52% respectively, which were rather high. A previous study carried out at AIIMS, Delhi, showed a 17.27% rate of catheter related sepsis [10]. The high rate of IV catheter sepsis observed by us may be due to the multipurpose use of a single lumen catheter with a three way connection and the lack of a specialized IV catheter care team. The commonest organisms which were found to be colonizing the catheter and causing bacteraemia were *S.aureus* (43.54%) and *Candida spp.* (24.19%). These results are

consistent with the findings of a previous study [11]. *S.aureus* colonizes the anterior nares of healthcare personnel and such carriers are important sources of infections. The present study showed that 25.45% of the healthcare personnel are carriers of MRSA. In the current study, *K.pneumoniae* and *S.aureus (*41% MRSA) were the predominant isolates. Studies showed that the nosocomial pathogens were probably unique to each ICU [8]. The standard of the practices followed in the ICUs could have contributed to the nature of the flora and the infection rate. There was an alarming increased incidence of NIs caused by multi drug resistant gram negative bacilli and MRSA in our study, which was consistent with a previous study [8].

The present study on the microbiological profiles of the nosocomial infections showed that the rate of NIs is high, even though it was within the reported range. The risk of the development of NIs was directly related to the duration of ICU stay and the duration of the use of the indwelling catheters/tubes. The prolonged use of indwelling devices need careful prophylactic standards of microbiological monitoring. The empirical and the indiscriminate use of antibiotics should be avoided in order to curtail the emergence and the spread of drug resistance among nosocomial pathogens. This study gives an insight into the incidence of NIs and helps in instituting various interventional strategies to prevent these infections.

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