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Research Paper

Bacteriology of Nosocomial Pneumonias In Patients on Mechanical Ventilation

Medical Science

KEYWORDS : VAP, ICU patients

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ABSTRACT

Introduction: Eighty-six percent of nosocomial pneumonias are associated with mechanical ventilation (MV). It is commonest complication in ICU patients reported at the rate of 1-3% per day of MV in tertiary care hospitals. In spite of the advances in the diagnosis, treatment and prevention, it continues to be a major cause of morbidity and mortality among critically ill patients. Objectives: To isolate bacterial pathogens causing VAP and determine their antimicrobial susceptibility. Materials and Methods: A prospective study was conducted in the Department of Microbiology, Government Medical College & Hospital, Amritsar over a period of one and a half year for patients admitted in ICU who required mechanical ventilation and who fulfilled both clinical and microbiological criteria for VAP. The respiratory specimens were collected under aseptic conditions and transported immediately to the laboratory and processed in the Microbiology laboratory by standard microbiological procedures. All the isolates were further identified by biochemical tests and their antimicrobial susceptibility was determined. Results: Out of total patients, the most common organisms isolated were Acinetobacter spp (33.33%) and Pseudomonas spp (30.23%) followed by Staphylococcus spp (13.95%) Klebsiella spp (11.62%), Escherichia coli (6.20%), CONS (3.10%) and Citrobacter spp (1.55%). Conclusions: Mechanical Ventilation is a life saving intervention, it has its own potential complications. Early, accurate diagnosis is, therefore, fundamental in patients with VAP.

INTRODUCTION:

Ventilator associated pneumonia (VAP) has been defined as bacterial pneumonias developing in patients after atleast 48 hours of mechanical ventilation and not at the time of intubation or admission to the hospital[1]. It is associated with increased morbidity, mortality and costs and mortality rate for VAP ranges from 24 to 50% and can reach 76% in some specific settings or when lung infection is caused by high risk pathogens[2]. Despite major advances in techniques for the management of ventilator dependent patients and the routine use of effective procedures to disinfect respiratory equipments, VAP continues to complicate the course of 8 to 28% of the patients receiving mechanical ventilation. Rates of pneumonia are considerably higher among patients hospitalized in intensive care units compared with those in hospital wards and risk of pneumonia is increased 3-10 fold for the intubated patient receiving mechanical ventilation.

Most of the organisms responsible for VAP are rapidly developing resistance to the majority of the antimicrobials including aminoglycosides, fluoroquinolones and cephalosporins which was once considered as the drug of choice. Extended-spectrum beta lactamases (ESBLs) and Amp C beta lactamases are of increasing clinical concern in these patients and are most commonly produced by the members of family enterobacteriaceae. Acquisition of plasmid mediated metallo beta lactamases active against carbapenems have been reported in *Pseudomonas aeruginosa* and *Acinetobacter spp*[3].

Delayed diagnosis and subsequent delay in initiating appropriate therapy may be associated with worse outcomes in patients with VAP. On the other hand, an incorrect diagnosis may lead to unnecessary treatment and subsequent complications related to therapy. Early, accurate diagnosis is, therefore, fundamental in the management of patients with VAP.

MATERIAL AND METHODS:

A prospective study was conducted in the Department of Microbiology, Government Medical College & Hospital, Amritsar for patients admitted in ICU for a period of one and a half years who required mechanical ventilation and who fulfilled both clinical and microbiological criteria were considered to be suffering from VAP. The respiratory specimens included Endotracheal secretions and were collected under aseptic conditions and transported immediately to the laboratory and processed in the Microbiology laboratory by standard microbiological procedures. All the isolates were further identified by biochemical tests and other additional standard microbiological laboratory techniques.

INCLUSION CRITERIA: Patients on ventilator support for > 48 hours and New or progressive and persistent infilterate on chest radiograph.

Two of three of the following: Alteration in thermoregulation < 36° or >38°C, Leucocytosis (> 10,000) or Leucopenia (< 4000 per mm^3), Purulent tracheobronchial secretions.

A total of 386 patients who were on mechanical ventilation for more than 48 hours admitted in Intensive Care Unit were observed and among them only 196 patients were included in the study on the basis of inclusion criteria. All the patients were monitored for the development of Ventilator-associated pneumonia using clinical and microbiological criteria. A clinical suspicion of VAP was made in patients with a modified Clinical Pulmonary Infection Score>6. Gram's staining and semiquantitative culture of tracheal aspirates was performed. The bacterial pathogens were isolated from the specimen and their antimicrobial susceptibility pattern was determined. The observations and data obtained from the study were compiled and analyzed. All the results were depicted in the tables and graphs.

OBSERVATIONS AND RESULTS:

In the present study of clinically suspected cases of VAP, (64.80%) were males and (35.20%) were females. The male: female ratio was 1.84:1. Most cases of VAP were of late onset (72.96%) as compared to (27.04%) cases which were of early onset. Out of total specimens, (65.82%) samples were culture positive and (34.18%) had no growth of pyogenic organism after 24 hours of incubation. Out of all culture positive samples (82.95%) were gram negative organisms and (17.05%) were gram positive.

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TABLE 1:

RISKFACTORS/ COMORBIDITIES	NO. OF CASES	PERCENTAGE (%)
Prior antibiotics (<2weeks)	127	64.80
Prior hospitalisation (<2 weeks)	044	22.45
Aspiration	035	17.86
Enteral nutrition	028	14.28
Supine position	024	12.25
Reintubation	018	09.18
Immunosupression	010	05.10

TABLE 2

TABLE SHOWING TYPE OF BACTERIA ISOLATED

NAME OF ORGANISM	PERCENTAGE (%)
Acinetobacter baumanii	33.33
Pseudomonas aeruginosa	30.23
Klebsiella pneumonia	11.62
Escherichia coli	06.20
Citrobacter spp	01.55
Staphylococcus aureus	13.95
Coagulase negative Staphylococcus (CONS)	03.10

TABLE 3: ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF GRAM POSITIVE ISOLATES

Organisms	Sensitivity	A	Ak	G	CF	Cs	CN	A-CLAV	E	LZ	Va
S. aureus	S	07 (38.89%)	12 (66.67%)	08 (44.44%)	08 (44.44%)	06 (33.33%)	17 (94.44%)	16 (88.89%)	07 (38.89%)	18 (100%)	18 (100%)
CONS	S	01 (25.00%)	03 (75.00%)	01 (25.00%)	02 (50.00%)	01 (25.00%)	04 (100%)	04 (100%)	02 (50.00%)	04 (100%)	04 (100%)

A-Ampicillin, Ak-Amikacin, G-Gentamicin, CF-Ciprofloxacin, Cs-Cephalaxin, CN-Cefoxitin, A-clav-Amoxycillin Clavulanate, E- Erythromycin, Lz- Linezolid, Va- Vancomycin

TABLE 4: ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF GRAM NEGATIVE ISOLATES

Organisms	Sensitivity	Ak	G	CF	CZ	CPZ	PCTZ	SbCZ	IMP
Acinetobacter baumanii	S	23 (53.49%)	15 (34.88%)	11 (25.58%)	23 (53.49%)	21 (48.84%)	38 (88.37%)	38 (88.37%)	41 (95.35%)
Pseudomonas aeruginosa	S	20 (51.28%)	15 (38.46%)	17 (43.59%)	24 (61.54%)	26 (66.67%)	35 (89.74%)	36 (92.31%)	38 (97.44%)
Klebsiella pneumonia	S	12 (80.00%)	08 (53.33%)	08 (53.33%)	12 (80.00%)	11 (73.33%)	13 (86.67%)	14 (93.33%)	15 (100.00%)
Escherichia coli	S	05 (62.50%)	03 (37.50%)	03 (37.50%)	06 (75.00%)	07 (87.50%)	07 (87.50%)	07 (87.50%)	08 (100.00%)
Citrobacter spp	S	02 (100.00%)	00	01 (50.00%)	01 (50.00%)	01 (50.00%)	02(100.00%)	02 (100.00%)	02 (100.00%)

Ak-Amikacin, G-Gentamicin, CF-Ciprofloxacin, CZ-Ceftazidime, CPZ-Cefoperazone, PCTZ-Piperacillin Tazobactam, SbCZ- Ceftizidime Sulbactam, Imp-Imipenem

DISCUSSION:

In our study the rate of VAP was 47.16 per 1000 ventilator days which is concordant with the study done by Elatrous et al who conducted a 1 year cohort survey on 73 consecutive mechanically ventilated patients exceeding 48 hours; it was found that VAP developed in 38% of cases, yielding an incidence of 46 per 1000 ventilator days[4]. Another study done by Guimaraes et al on 278 patients who received ventilation for more than 48 hours, VAP developed in 106 (38.1%) patients and the VAP rate was found to be 35.7 per 1000 ventilator days[5].

In our study the most common risk factor associated with the development of VAP was prior use of antibiotics (64.80%) followed by aspiration (17.86%), enteral nutrition (14.28%) and supine position (12.25%) (Table 1) which is similar to study done by Rajashekhar et al, who found that prior use of antibiotics (72.7%) was the most common risk factor found to be associated with VAP[6]. Other risk factors in his study were reintubation, duration of mechanical ventilation, surgery, nasogastric tube, tracheostomy, stress ulcer prophylaxis, IV sedation. It is now well known that prior use of broad spectrum antibiotics is responsible not only for VAP but also for the emergence of drug resistance. This affirms that preventive measures should be taken to reduce the risk factors associated with VAP. We also observed higher incidence of VAP in patients receiving prior antibiotics.

In our study, various comorbid factors were reintubation (9.18%) and conditions like steroid therapy which lead to immunosupression (5.10%) (Table1). In a prospective study by Gupta et al, it was found that patients who developed VAP had associated co-morbid conditions like diabetes mellitus (4.9%), hypertension (5.9%), ischaemic heart disease (2%), smoking (5.4%), alcohol (10.8%), pregnancy (6.9%)[7]. The comorbid conditions play a major role in development of complications in patients admitted in ICU.

In our study among gram negative bacteria, *Acinetobacter baumannii* (33.33%) and *Pseudomonas aeruginosa* (30.23%) were found to be predominant followed by*Klebsiella pneumoniae* (11.62%), *Escherichia coli* (6.20%) and *Citrobacterspp*(1.55%) (Table 2) which is concordant with a study done by Singhal R and associates in 2005 who also reported among gram negative bacteria, commonest isolate was *Acinetobacter spp* (44.8%) followed by *Pseudomonas spp* (40.1%). Other isolates were *Klebsiella pneumoniae*(5.7%), *Escherichia coli* (4.2%), *Citrobacter spp* (2.1%), *Enterobacter spp* (1.6%) and 1 isolate of *Serratia marcesans*[8].

In our study,among gram positive organisms,*Staphylococcus aureus* (13.95%) was the most common isolate followed by *Coagulase negative Staphylococcus* (3.10%) (Table 2). In a similar studygram positive cocci accounted for 45.3%, out of which *Streptococcus spp* were commonest (13.5%) followed by Methicillin resistant *Staphylococcus aureus* (MRSA) (13.1%), Methicillin sensitive *Staphylococcus aureus* (MSSA) (8.2%), *Enterococcus spp* (2%). The varying pattern of organisms emphasizes the importance of studying the pattern of infection in every setting.

In our study, all the isolates of *Acinetobacter baumannii* showed highest susceptibility to Imipenem (95.35%) followed by Piperacillin/Tazobactam (88.37%) and Ceftazidime/Sulbactam (88.37%). Maximum resistance was seen to Ciprofloxacin (74.42%) followed by Gentamicin (65.12 %), Amikacin (46.51%) and Ceftazidime (46.51%) (Table 3).The antimicrobial susceptibility pattern of our study was in concordance with the study done by Shete et al in which *Acinetobacter spp*showed the maximum resistance against third and fourth generation cephalosporins, fluoroquinolones and aminogylcosides[9].

In our study *Pseudomonas aeruginosa* showed maximum sensitivity to Imipenem (97.44%) followed by Ceftazidime/Sulbactam (92.31%) and Piperacillin/Tazobactam (89.74%). Similar results were quoted in a study done by Agarwal et al who showed that *Pseudomonas aeruginosa* was highly sensitive to Imipenem (91.95%)[78]. In another study done by Javiya et al *Pseudomonas aeruginosa* was highly sensitive to Imipenem (78.57%) and remarkably resistant to other group of antibiotics i.e 67.86% for third generation Cephalosporins and 58-62% for Cephalosporins[10].

In our study among gram positive isolates,*Staphylococcus aureus* was the most common followed by *Coagulase negative staphylococcus*. All the isolates showed maximum sensitivity to Vancomycin and Linezolid (100% each). MRSA was isolated in 5.56% of the cases (Table 4). In a prospective study by Joseph et al, *Staphylococcus aureus* was the only Gram positive organism isolated among patients with VAP while MRSA accounted for 42.9% of *Staphylococcus* isolates[11].

In spite of preventive methods, VAP presents a challenge when selecting antibiotic coverage. VAP is associated with an attributable increase in morbidity and mortality. The mortality attributable to VAP is difficult to quantify as it is influenced by many different factors including type of infecting organism, underlying comorbidity, severity of host response and timing of onset. Its development prolongs patient's stay in the ICU. Despite their potential preventability, VAP still impose a substantial burden on critically ill patients.

CONCLUSION:

Use of mechanical ventilators has increased many folds in recent times. Though a life saving intervention, it has its own potential complications. The incidence of VAP-attributable mortality is difficult to quantify due to the possible confounding effect of associated conditions, but VAP is thought to increase the mortality of the underlying disease by about 30%. Delayed diagnosis and subsequent delay in initiating appropriate therapy may be associated with worse outcomes in patients with VAP. On the other hand, an incorrect diagnosis may lead to unnecessary treatment and subsequent complications related to therapy. Proper disinfection of ventilators and other instruments is required to prevent it.

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