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A Study on Antimicrobial Susceptibility Pattern of Common Etiological Agents from Ventilator Associated Pneumonia in a Tertiary Care Hospital

Azeem Ahamed and P. Neelu Sree*

Department of Microbiology, Saveetha Medical College and Hospital, Chennai, India
*Corresponding author

A B S T R A C T

Ventilator-Associated Pneumonia (VAP) is an important hospital-acquired infection with substantial mortality. Only a few studies are available from India addressing the microbiological aspects of VAP, which have been done with small study populations. The study was carried out in the intensive care units (ICUs) of a tertiary care hospital to assess the profile of pathogens and to determine the pattern of antimicrobial resistance. This was a retrospective study of clinically suspected cases of VAP. Over a one year period, a total of 50 cases were subjected from 2017 – 2018 in ICUs on mechanical ventilation with clinical evidence of VAP were included in our study. Sputum, Endotracheal aspirate and broncho-alveolar lavage samples which were collected and sent to microbiology lab for culture were analysed in our study. The common isolates and their antimicrobial susceptibility pattern were analysed in detail. On statistical analysis, male patients were more prone to develop Ventilator Associated Pneumonia infection than female patients. Also patients of age group 51 years and more were found to be most commonly affected because of their associated co-morbid conditions. Among the bacterial isolates *Klebsiella pneumoniae* was predominant followed by *Acinetobacter baumanii*. Among fungal agents *Candida albicans* was found to be the most common agent, but isolated in a very minimal number. VAP shows a significant increase in morbidity and mortality now a days. Increased numbers noted in intensive care units. The incidence of multidrug resistant pathogens was on the rise. The resistance pattern of these pathogens can help an institution to formulate effective antimicrobial policies. To have a comprehensive pan-India picture, multicentric studies are needed.

Introduction

Ventilator associated pneumonia is a nosocomial pneumonia (not present at the time of airway intubation) developing in mechanically ventilated patients. Mechanical ventilation is defined as any period of respiratory support with tracheal intubation. Ventilator-Associated Pneumonia is a significant form of HAP (Hospital-Acquired Pneumonia). It causes development of infection of lung parenchyma after patients had experienced intubation for over 48 hours and got the mechanical ventilation for over 48 hours or the tracheostomy.

Ventilator associated pneumonia is divided into two groups based upon mechanical ventilation duration: early onset VAP (taking place after 2 to 4 days) and late onset VAP

(taking place after day 5). Normally, bacteria leading to early onset VAP comprise *Streptococcus pneumoniae* (in addition to other *Streptococcus* genus), MSSA (Methicillin Sensitive *Staphylococcus aureus*),

Antibiotic-sensitive Enteric gram-negative bacilli, *Hemophillus influenza*, *Escherichia coli*, *Enterobatcer* genus, *Proteus* species, *Serratia marcescens* and *Klebsiella pneumoniae*. Late onset culprits are generally multidrug resistant bacteria, for example MRSA (Methicillin Resistant *Staphlococcus aureus*), *Pseudomonas aeruginosa*, *Acinetobacter* and ESBL (extended spectrum betalactamase) producing bacteria.

Diagnosis of VAP is a difficult problem and presents a major diagnostic challenge, because the rehabilitate of the criteria commonly used to diagnose pneumonia is uncertain in MV patients. In MV patients, the clinical and microbiological distinction between colonization and infection is often extremely difficult. There is considerable controversy on the sampling techniques used in diagnosing bacterial pneumonia and in identifying the causal pathogen. Quantitative culture of samples obtained by bronchoscopic techniques, such as protected specimen brush (PAS) and bronchoalveolar lavage (BAL) have shown satisfactory diagnostic accuracy for the diagnosis of VAP. These methods are invasive, expensive and not exempt from complications requiring bronchoscopic procedure, which is a technique not always available 24 hours a day in the intensive care setting.

The main objective of the present study was the isolation and identification of bacteria causing VAP, testing their antimicrobial susceptibility pattern in order to make recommendations to minimize risk of occurrence of VAP in hospitals.

Materials and Methods

This retrospective study was carried out on 50 patients clinically diagnosed as VAP in intensive care units of a tertiary care hospital; 36 males and 14 females, selected from those attending medical and surgical ICUs of a tertiary care hospital. The various age groups taken for the study were 0-20 years, 20-50years and above 50 years. The inclusion criteria were that they had been mechanically ventilated for more than 48 hours and on clinical grounds were suspected to have VAP.

Direct gram stained films were examined for the presence of microorganisms, epithelial cells, neutrophils and macrophages. All organisms isolated were identified by standard laboratory methods using blood agar, chocolate agar, MacConkey agar. Automated Bactec and Vitek identification systems were used for confirmation.

Antimicrobial susceptibility testing was performed on Muller-Hinton agar using Kirby-Bauer disc diffusion method. The antibiotic discs were selected according to the protocol as recommended by Clinical laboratory Standards Institute (CLSI).

Results and Discussion

Our retrospective study was carried out for a period of one year from January 2018 – December 2018 in a tertiary care hospital on ICU patients clinically diagnosed as VAP and confirmed through laboratory methods using standard methods revealed the following results.

Results analysed as per the clinical and laboratory findings from our tertiary care hospital. Our statistical analysis carried out based on

Demographic details of VAP patients
Samples analysed for VAP

Common etiological agents from VAP patients

Antibiotic susceptibility pattern

Incidence of HAP was seen to be much higher at 58%(n=29) for patients aged above 50 years followed by the age group between 20-50 years(n=14) and was least in the age group between 0-20years(n=7) as shown in figure 1 and table 1.

Among the samples analysed in our study, Endotracheal aspirate was sent predominantly for laboratory analysis of VAP (n=31) followed by sputum(n=11) and bronchoalveolar lavage (n=8) as shown in figure 2 and table 2.

Among the bacterial isolates collected, the most predominant was *Klebsiella pneumoniae* (n=28) 56% followed by *Acinetobacter baumanii* 24% (n=12), *Pseudomonas aeruginosa* 12% (n=6), *Escherichia coli* 4% (n=2), *Enterobacter cloacae* 2% (n=1).

In our study on analysing the common fungal agents isolated from VAP, *Candida albicans* was isolated at a very minimal no (n=1) 2% as shown in figure 3 and table 3.

Antibiotic susceptibility pattern

The antimicrobial susceptibility pattern of the common etiological agents as per CLSI guidelines confers that *Klebsiella pneumoniae* 12 (42.85%) were sensitive to Amikacin, 8 (28.57%) to cefoperazone sulbactam, 6 (21.42%) to Imipinem, 5 (17.85%) to Ciprofloxacin, 4 (14.28%) to Cotrimoxazole

and ceftazidime. While 28(100%) were resistant to Cefipime. *Pseudomonas aeruginosa* were found sensitive to Amikacin and cefoperazone sulbactam were 5(83.33%), Imipinem 4(66.66%), ceftazidime and ciprofloxacin 2(33.33%), cefipime 1(16.66%). While cotrimoxazole 6(100%) showed complete resistance .

Acinetobacter baumannii isolates were found sensitive to cefoperazone sulbactam and cotrimoxazole 5(41.66%), ciprofloxacin 3(25.0%), cefipime, Amikacin, Imipinem and ceftazidime showed a similar sensitivity of 2 (16.66%) (Table 4).

This retrospective study was carried out in the department of microbiology, in a tertiary care hospital, Thandalam on Ventilator-Associated Pneumonia with significant clinical history of hospital acquired pneumonia. The common etiological agents and their antimicrobial susceptibility pattern were studied in detail.

In our study when we analysed the demographic details of the study subjects, the commonest age group was 50 years and above similar to other studies done by Umar Khalid cheema *et al.,* (1) and Abdulrahman M Alqurashi*, et al.,* (2) which showed VAP is found more increasingly in elderly age groups, reason behind this could be their associated co-morbid conditions, immune compromised state, long term antibiotics, long term steroids.

In our study, we analysed the samples predominantly sent to the laboratory for microbiological analysis of VAP, ET 31(62%) followed by BAL 8(16%) and sputum 11(22%) which is in accordance to other studies which predominantly showed ET samples done by Abdulrahman M. Alqurashi, *et al.,* (2) and Chittawatanarat *et al.,*(3).

Table.1 Demographic details of study subjects

Age groups	Number of people	%
0-20 years	7	14%
20-50 years	14	28.0%
Above 50 years	29	58.0%

Table.2 Samples analysed for VAP

Samples	No of samples	%
ET	31	62.0%
BAL	8	16.0%
Sputum	11	22.0%

Table.3 Common etiological agents isolated from VAP

Isolates	No of isolates	%
Klebsiellapneumoniae	28	56.0%
Pseudomonas aeruginosa	6	12.0%
Escherichia coli	2	4.0%
Candida albicans	1	2.0%
Acinetobacter baumannii	12	24.0%
Enterobacter cloacae	1	2.0%

Table.4 Antimicrobial susceptibility pattern

| Antibiotic	Klebsiella pneumoniae	Pseudomonas aeruginosa	Escherichia coli	Acinetobacter baumanni	Enterobacter cloacae
Amikacin	12 (42.85%)	5(83.33%)	0(0%)	2(16.66%)	0(0%)
Imipinem	6(21.42%)	4(66.66%)	1(50%)	2(16.66%)	0(0%)
Ceftazidime	4(14.28%)	2(33.33%)	0(0%)	2(16.66%)	0(0%)
Cefoperazone sulbactam	8(28.57%)	5(83.33%)	1(50%)	5(41.66%)	0(0%)
Cotrimoxazole	4(14.28%)	0 (0%)	0(0%)	5(41.66%)	0(0%)
Cefipime	0(0%)	1(16.66%)	0(0%)	2(16.66%)	0(0%)
Ciprofloxacin	5(17.85%)	2(33.33%)	0(0%)	3(25.0%)	0(0%)
Total no of bacterial strains	28	6	2	12	1
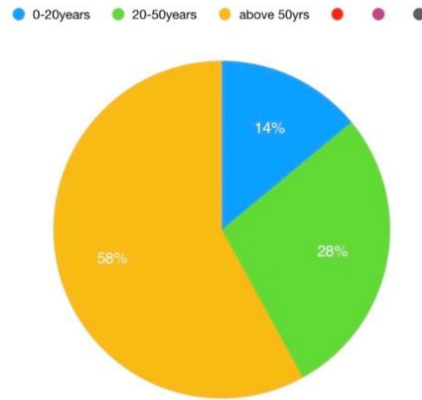
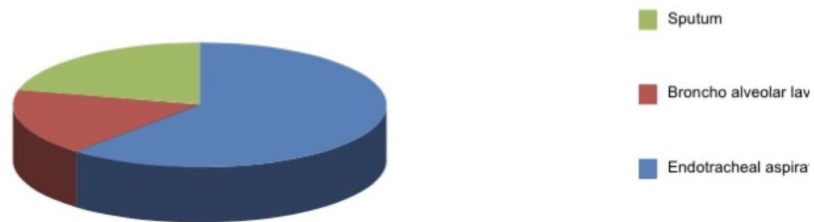Fig 1: Age wise distribution of VAP patients

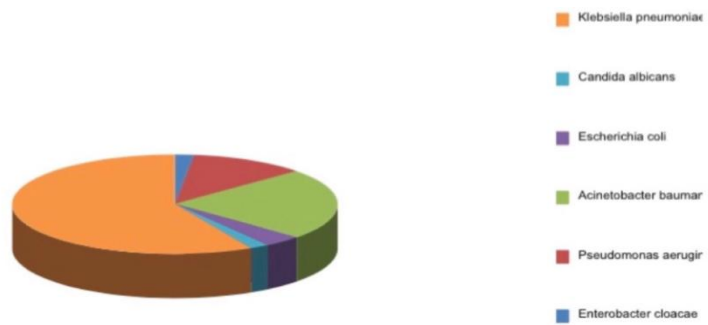**Fig.2** Predominance of samples collected

Fig 3: Etiological agents isolated from VAP

The common sample to be analysed for isolating the etiological agents of VAP patients would be ET secretions followed by BAL and sputum.

In our study the common isolates were *Klebsiella pneumonia* with an incidence of 56% followed by *Acinetobacter baumannii* with an incidence of 24%, similar to another study done by Abdulrahman M. Alqurashi, *et al.,(2)* which showed increased no *Klebsiella pneumonia* and *Acinetobacter baumannii* in accordance to the number of study subjects included in their study and their duration of study. *Acinetobacter baumannii* and *Klebsiella pneumonia* both are ESBL producers and multi drug resistant organisms which may be the reason for increased

mortality in these patients. In our study done to find antimicrobial susceptibility pattern:

Klebsiella Pneumoniae showed maximum sensitivity to amikacin and imipenem which was similar to another study conducted which conferred 91% sensitivity to Imipinem and 50% sensitivity to Amikacin respectively done by Abdulrahman M. Alqurashi, *et al.,*(2). It was also concurrent with a similar study that showed a predominant Imipinem sensitivity at 50% done by Zorana M. Djordjevic *et al., (4).* Another study done by Shamataj Kattalgere Razak *et al.,* (5) also showed a predominant Amikacin sensitivity at 13.7%

Klebsiella showed 100% resistance to Cefipime which is in contrast to a similar study conducted which showed 60% sensitivity to the same drug done by Umar Khalidcheema *et al.,* (1). Ciprofloxacin showed 17.85% sensitivity in our study which was in contrast with another study that showed 100% resistance to the same drug done by Shamataj Kattalgere Razak *et al.,* (5).

For *Acinetobacter baumannii* species

Cotrimoxazole, cefoperazone sulbactam and ciprofloxacin showed maximum sensitivity respectively while a similar study showed 5% sensitivity to ciprofloxacin conducted by Zorana M Djordjevic *et al., (4).*

In another study ciprofloxacin showed sensitivity at 7% for ciprofloxacin conducted by Shamataj Kattalgere Razak *et al., (5).* Cefipime which showed 2% sensitivity in our study is in contrast to a similar study which shows complete resistance (100%) to the same drug conducted by Umar Khalid Cheema, *et al.,(1).* On analysing the antimicrobial susceptibility pattern of the common isolates, Cefipime shows 100% resistance in both the common organisms. So the preferred drug of choice would be ceftazidime among the cephalosporins, Imipinem, or combination

drugs cefaparazone sulbactum for ESBL producers.

In the present study *Candida albicans* was isolated at a very minimal number in contrary to other studies in which no fungal pathogens were isolated. Still fungal agents could be a common cause of VAP on patients on long term steroids, immuno- suppression.

Increased rates of VAP are isolated in all hospitals in the Intensive care units. Rates are high among all the hospital acquired infections. The common multi drug resistant organisms *Acinetobacter baumannii* and Klebsiella pneumonia ESBL producers are isolated from those patients which makes the treatment difficult. Increased morbidity and mortality are observed in those patients. Similar studies would help in revising and modifying the antibiotic policies of their hospital.

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