

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.903.361>

Bacteriological Profile of Early and Late onset Ventilator Associated Pneumonia

S. Sadiqa Begum^{1*}, Mariraj Jeer² and S. Krishna²

¹Department of Microbiology, Subbaya Institute of Medical Sciences, Shimoga-577201, India

²Vijayanagara Institute of Medical Sciences, Ballari-583101, India

*Corresponding author

ABSTRACT

Ventilator-associated pneumonia is a common complication in intensive care units, occurring in 9% to 24% of patients intubated for longer than 48 hours. This study aims to determine bacteriological profile of early and late onset VAP and its antibiotic susceptibility pattern. A prospective study was performed in the ICU setting of a tertiary care hospital (VIMS, Ballari) over a period of 1 year. ETA culture of 68 patients with a clinical suspicion of VAP were analysed by standard microbiological procedures. The present study showed GNB as the most common organism isolated. *Pseudomonas spp* (24.6%), followed by *Klebsiella spp* (22.8%), *Acenitobacter spp* (12.3%), former being predominant in early onset variety & the latter in the late onset VAP. Other organisms like *E.coli*, *Citrobacter species*, *Proteus species*, *staphylococcus aureus* and *CONS* are isolated in their decreasing frequency. Most of the organisms are resistance to Beta lactams and cephalosporins but sensitive to carbepenems. The Bacteriological culture of endobroncheal aspirates is helpful in the diagnosis and management of VAP. MDR is seen in most patients of VAP, Carbepenems are effective in treatment.

Keywords

VAP, Mechanical ventilation, MDR, Endotracheal aspirate (ETA)

Article Info

Accepted:

25 February 2020

Available Online:

10 March 2020

Introduction

HAP and VAP represented the second most common nosocomial infection affecting approximately 27% of all critically ill patients¹. Ventilator-associated pneumonia is a common complication in intensive care units, occurring in 9% to 24% of patients intubated for longer than 48 hours². Ventilator-

associated pneumonia (VAP) is defined as pneumonia occurring in a mechanically ventilated patient after 48 hours of endotracheal intubation³. Microorganisms responsible for VAP may differ according to the population of patients in the ICU, the durations of hospital and ICU stays, and the specific diagnostic methods used⁴. Major bacterial isolates from HAP and VAP cases in

Asian countries were *Acinetobacter spp*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Klebsiella pneumoniae*⁵.

The spectrum of potential pathogens can be defined by assessment of a variety of factors, including the severity of the pneumonia itself, the presence of specific co-existing illness, prior therapy (including antibiotics), and length of hospitalization⁶. Quantitative endotracheal aspirate culture is a useful non-invasive tool for the diagnosis of pneumonia pathogens in critically ill patients, findings suggest that a threshold level of 10⁶cfu/mL is appropriate because at this level excellent concordance was found with quantitative BAL culture results⁷. So the aim of the study is to determine bacteriological profile of early onset and late onset VAP from ETA samples and its antibiotic susceptibility pattern for the optimal treatment of patients and to control the spread of resistance.

Materials and Methods

A prospective study done enrolling patients, from the ICU of our hospital, VIMS Ballari for a period of One year (From January 2015 to December 2015). Intubated patients (>18 years of age) who are mechanically ventilated for more than 48 hours, with a clinical suspicion of ventilator-associated pneumonia, patients with two of the following: Fever ≥ 38 °C, Purulent Bronchial Secretions, and WBC more than 10,000/mm³ or <3000/mm³ were included in the study. Patients with pneumonia or any pre-existing lower respiratory tract infections at the time of admission or first 48hrs of mechanical ventilation were excluded in this study. Clinically diagnosed Ventilator associated pneumonia cases were observed and data such as name, age, gender, date of admission into intensive care unit, chief complaints, risk factors involved, duration of mechanical ventilation were obtained. Data related to general physical examination,

radiological and haematological investigations was also collected.

Endotracheal aspirate (ETA) was collected under aseptic precautions. A sterile 22 inches suction catheter (Ramsons) was introduced into respiratory tract for a distance of 20-25cms and the specimen was aspirated into a sterile container. The sample was transported to the laboratory immediately for processing.

The ETA so collected was subjected to Gram's stain (Microscopy). The specimen was further diluted using sterile saline (1 in 100) and the dilution factor was noted and the specimen was then inoculated for quantitative culture using standard techniques onto MacConkey agar, Blood agar and Chocolate agar plates using a 4mm sterile nichrome loop (0.01 ml), and then incubated at 37°C. The plates were examined for growth at 24 hrs, and if there was no growth, it was further incubated for another 24hrs. The CFU/ml was then calculated, considering the dilution factor.

CFU/ml = No. of colonies grown x Dilution Factor (10²) x Reciprocal of volume (ml) of specimen used for inoculation (10²).

Bacterial growth with > 10⁶ CFU/ml was given significance as a pathogen and was further identified using appropriate biochemical tests. The antibiotic susceptibility testing was performed according to CLSI guidelines.

Results and Discussion

A prospective study was done enrolling 68 patients out of 240 patients on mechanical ventilation as per the inclusion criteria, and the following results were obtained. Of the total 68 patients suspected to have VAP, 52 (76.5%) developed true VAP as per the diagnostic criteria. Incidence rate of VAP in

our study is 21.7%. The significant peak of incidence is seen in 25-45yrs of age group. Among these 46 (67.6%) were male and 22 (32.4%) were females. Late onset pneumonia was suspected in 31 (59.6%) cases and early onset pneumonia in 21(40.4%) cases. Out of 52 cases of true VAP, 24(46%) were admitted for Surgical problems, 16(30%) for medical problems and 12(23%) for others. Total mortality rate was 21%

Out of the 52 cases, 47(90.4%) had monomicrobial bacterial growth and 5(9.6%) cases showed polymicrobial growth and 16(23.5%) cases had no significant growth on culture. 70.2% of Gram negative bacteria and 29.8% of Gram positive isolates were isolated. The predominant GNB isolated in our study is *Pseudomonas spp* (24.6%), followed by *KlebsiellaSpp* (22.8%), *AcinetobacterSpp* (12.3%), *CitrobacterSpp* (7.2%), *E.coli* (1.7%), *Proteus Spp* (1.7%)(Graph 1). Amongst the Gram positive isolates *Staphylococcus aureus* (22.8%) was most frequently isolated. 70% of GNB are ESBL producer and 10(77%) are MRSA and 3(22%) are MSSA.

VAP is the most prevalent nosocomial infection, leading to increased hospital stay, high cost, morbidity and mortality. In different studies, the incidence of VAP was reported different; depending on the type of hospital or ICU, the population studied and the organisms prevalent; and varied from 7% to 70%. This study was conducted to assess the bacterial etiological agents leading to early and late onset VAP.

Our study showed occurrence of VAP to be 21.7%, which was in close agreement with a study conducted on Nosocomial pneumonia by Vincent JL (2001)⁸. In a South Indian

study, Rakshith P. *et al.*,⁹(2005) reported the incidence to be 26 per 1000 ventilator days.

The patients studied belonged predominantly to the age group of 25-45 years with a significant peak incidence of 42.6 similar to 40-49yrs in a study by Nigeria by V. Olugbue¹⁰(2011). Late onset VAP (59.6%) was predominant in our study. The more the number of days the patient is on a ventilator, the higher is chance of getting pneumonia. This has been proved beyond doubt by Sanmath K *et al.*,¹¹ where 90.32% developed Late onset VAP and 34.83% developed early VAP. In the present study, Surgical conditions -post-operative procedures (46%) is the most common risk factor noted followed by medical conditions (30.7%).

In our study, the incidence of aerobic gram negative bacteria is 70.2% and this high incidence correlated with other studies like Kanj SS *et al.*,¹² which showed incidence of GNB of 83%. Johanson *et al.*, isolated 22 isolates of GNB from 26 patients with nosocomial respiratory infection¹³.

In a study of Dr.HinaGadani *et al.*,¹⁴, The order of prevalence of organism in VAP cases was found to be *Pseudomonas* (43.2%), *Klebsiella* (18.91%), followed by MRSA, *Escherichia coli*, *Acinetobacter*, *Methicillin Sensitive Staphylococcus aureus (MSSA)* and *Streptococcus pneumonia* which is similar to our study.

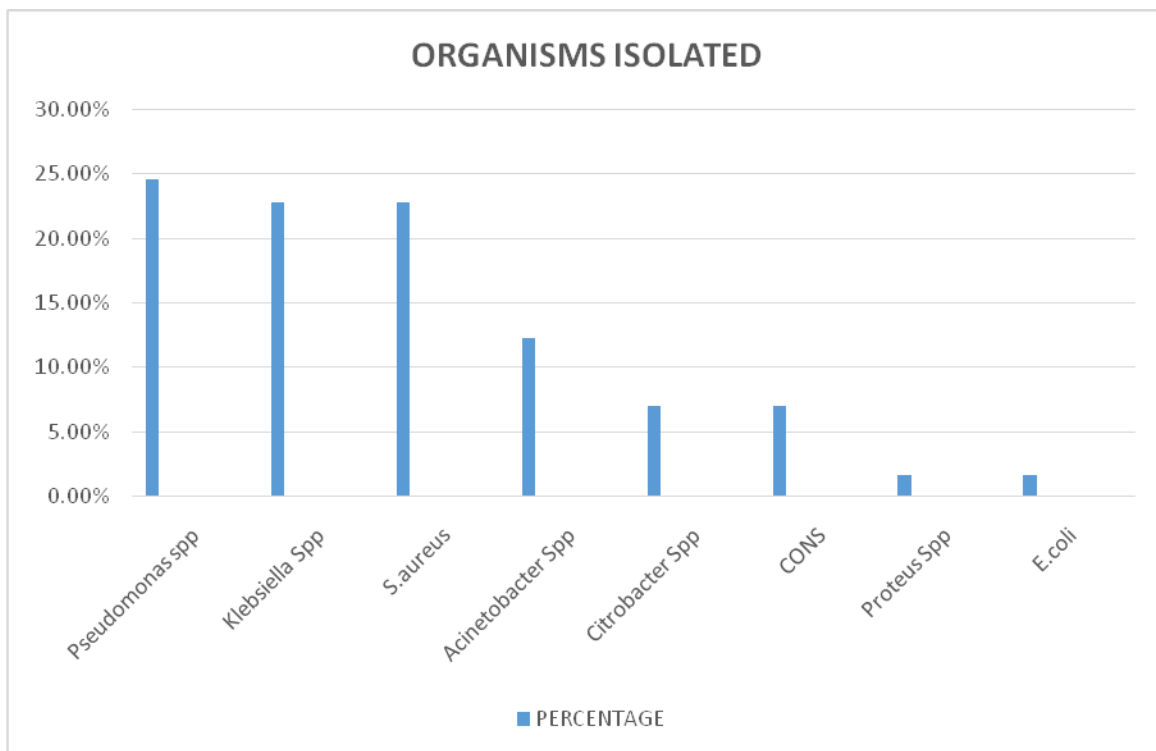
In early onset VAP, the organism most commonly isolated was *Pseudomonas spp* accounting for 30.4% of all isolates. *Klebsiellaspp* (23.5%) followed by *Acinetobacter spp* (20.6%) were the most common organism isolated in Late VAP(Table 1).

Table.1 Frequency of organism distribution in Early & Late VAP

S. No	Isolate	Early VAP		Late VAP	
		No=23	%	No=34	%
1.	<i>Pseudomonas spp</i>	7	30.4	7	20.9
2.	<i>Klebsiella spp</i>	5	21.7	8	23.5
	<i>K. oxytoca</i>	5	21.7	6	27.6
	<i>K.pneumoniae</i>	Nil		2	5.9
3.	<i>Staphylococcus aureus</i>	6	26.1	7	20.6
4.	<i>Acinetobacter spp</i>	Nil	-	7	20.6
5.	<i>Citrobacter koseri</i>	2	8.7	2	5.9
6.	CONS	2	8.7	2	5.9
7.	<i>Proteus mirabilis</i>	1	4.3	Nil	
8.	<i>E.coli</i>	1	4.3	Nil	

Among the isolated organism Non fermenter i.e *Pseudomonas spp* (30.4%) is most common causative agent in Early VAP. *Klebsiella oxytoca* (27.6%) is most common organism isolated in Late VAP.

Graph.1 Organism isolated



Pseudomonas (24.6%) was the most common isolate that was identified. The other significant Gram negative isolates implicated were, *Klebsiella spp*, *Acinetobacter baumannii*, *E.coli*, *Proteus spp*. Amongst the Gram positive isolates *Staphylococcus aureus* (22.8%) was most frequently isolated.

Fig.1 *Pseudomonas aeruginosa* on Nutrient agar



This study correlates with other studies. Ibrahim and co-workers found that the most common pathogen associated with early-onset VAP was *Pseudomonas aeruginosa* (25%)¹⁵. Rajasekhar *et al.*, (2006) in their study found that, the predominant organisms in the early onset VAP group were *Acinetobacter* and *Klebsiella*. In the late onset group *Pseudomonas* was the most predominant organism.

Nidhi goel *et al.*, study shows 82.4% of single organism and 11.0% of polymicrobial growth, similar to our study showing 90.4% monobacterial and 9.6% polymicrobial isolates¹⁷.

The organisms responsible for VAP vary according to case mix, institution, prior antibiotic exposure, local resistance patterns, length of mechanical ventilation, and specific diagnostic method(s) used.

Rajasekhar *et al.*, in 2006 studied the role of quantitative cultures of non - bronchoscopic samples in VAP. They concluded that a culture of lower respiratory tract samples obtained by non bronchoscopic method is a good alternative to bronchoscopic samples in the bacteriological diagnosis of VAP¹⁶. Most of the organisms are resistance to Beta lactams

and cephalosporins but sensitive to carbapenems. This prospective study has addressed the incidence and microbiology of VAP in our tertiary care center. Bacterial pathogens most frequently isolated are *Pseudomonas spp*, followed by *Klebsiella spp*, *Acinetobacter spp*, *Staphylococcus aureus*, *Citrobacter spp*, *E.coli*, *Proteus spp* in their decreasing order. In early onset VAP, the organism most common in our study was *Pseudomonas spp* accounting for 30.4% of all isolates. *Klebsiella spp* (23.5%) followed by *Acinetobacter spp* (20.6%) were the most common organism isolated in Late VAP.

Culture of ET aspirate is easy, cost-effective procedure which helps in identifying the organism. Thus the microbiological profile & sensitivity pattern of the local community helps in framing the appropriate institutional antibiotic policy for better outcomes.

References

- Campbell GD, Niederman MS, Broughton MA, Craven DE, Fein AM, Fink
Doo Ryeon Chung, Jae-Hoon Song *et al.*, High Prevalence of Multidrug-Resistant Nonfermenters in Hospital-acquired Pneumonia in Asia. *Am J Respir Crit Care Med* 2011;184:1409–1417.

- Girish L. Dandagi. Nosocomial pneumonia in critically ill patients. *Lung India*. 2010 Jul-Sep;27(3):149-153.
- Hina Gadani, Arun Vyas, Akhya Kumar Kar *et al.*, A study of ventilator associated pneumonia: incidence, outcome, risk factors and measure to be taken for prevention. *Indian journal of anaesthesia*. 2010 Nov-Dec; 54(6):535-540.
- Ibrahim EH, Ward S, Sherman RN, Kollef MH. A comparative analysis of patient with early-onset vs late-onset nosocomial pneumonia in the ICU setting. *Chest*. 2000;117:1434-1442.
- Jean Chastre and Jean-Yves Fagon. Ventilator-associated Pneumonia. *Am J Respir Crit Care Med*. 2002; 165:867-903.
- Johansen *et al.*, Nosocomial respiratory infections with gram negative bacilli. *Annals of internal medicine*. 1992; 77:701-706.
- Kanj SS, Kanafani ZA *et al.*, International Nosocomial infection control consortium findings of device associated infections rate in an intensive care unit of a Lebanese university hospital. *J Global Infect Dis*. 2012;4:15-21.
- Morehead RS, Pinto SJ. Ventilator-associated pneumonia. *Arch intern Med*. 2000;160:1926-36.
- MP *et al.*, American Thoracic Society. Hospital-acquired pneumonia in adults: diagnosis, assessment of severity, initial antimicrobial therapy, and preventive strategies. A consensus statement. *Am J Respir Crit Care Med*. 1995; 153: 1711-1725.
- Nidhi Goel, Uma Chaudhary, Ritu Aggarwal, Kiran Bala. Antibiotic sensitivity pattern of gram negative bacilli isolated from the lower respiratory tract of ventilated patients in the intensive care unit. *Indian J Crit Care Med* 2009;13:148-151.
- Olugbue V, Onuoha S. Prevalence and antibiotic sensitivity of bacterial agents involved in lower respiratory tract infections. *Int. J. Biol. Chem. Sci*. 2011 April; 5(2):774-781.
- Panwar Rakshit P, Nagar VS, Deshpande AK. Incidence, clinical outcome and risk stratification of ventilator-associated pneumonia: a prospective cohort study. *Indian J Crit Care Med*. 2005;9:211-6.
- Rajasekhar T, Anuradha K, Suhasini T, Lakshmi V. The role of quantitative cultures of non-bronchoscopic samples in ventilator associated pneumonia. *Indian J Med Microbiol*. 2006;24:107-13.
- Sanmath K Shetty *et al.*, A Study on risk factors and Microbial profile of Ventilator associated Pneumonia in Intensive care units of a Tertiary care centre. *J Basic Appl Med Sci*. 2015;2(2):23- 29.
- Shin YM, *et al.*, Usefulness of Quantitative Endotracheal Aspirate Cultures in Intensive Care Unit Patients with Suspected Pneumonia. *J Korean Med Sci*. 2011; 26:865-869.
- Thomas M File, Jr. Recommendations for Treatment of Hospital Acquired and Ventilator-Associated Pneumonia: Review of Recent International Guidelines. *Clinical Infectious Diseases*. 2010;51(S1):S42-S47.
- Zolfaghari PS, Wyncoll DLA. The tracheal tube: gateway to ventilator-associated pneumonia. *Critical Care*. 2011;15:310.

How to cite this article:

Sadiqa Begum, S., Mariraj Jeer and Krishna, S. 2020. Bacteriological Profile of Early and Late onset Ventilator Associated Pneumonia. *Int.J.Curr.Microbiol.App.Sci*. 9(03): 3151-3162. doi: <https://doi.org/10.20546/ijcmas.2020.903.361>