Bacteriological Profile of Ventilator Associated Pneumonia in a Tertiary Care Hospital and their Antibiotic Resistance Pattern

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ABSTRACT

Background: *Ventilator Associated Pneumonia is a common infectious disease that is found in intensive care unit (ICU), which occurs in 8-38% of patients who underwent mechanical ventilation. The study was conducted to find the Bacteriological Profile of Ventilator Associated Pneumonia and the antibiotic sensitivity pattern of the isolates.*

Materials & Methods: *A total of 84 bacterial isolates from 98 clinically suspected adult patients with VAP, who were admitted to the medical and surgical intensive care unit from January 2013 to December 2013 were examined. Clinical characteristics, bacterial pathogens, and resistance profiles were analyzed.*

Results: *Klebsiella spp. (23.80%) was the most common isolate that was identified. The other significant Gram negative isolates implicated were E. coli, Pseudomonas aeruginosa, Acenitobacter baumanii. Amongst the gram positive isolates Staphylococcus aureus (15.47%) was most frequently isolated from the transtracheal aspirates or bronchoalveolar lavage in patients with VAP. There was no significant difference of bacterial pathogens between early and late onset VAP.*

Conclusion: *The two most frequent pathogens of VAP were Klebsiella spp. and S. aureus. There were no pathogenic differences between early and late onset VAP.*

Key Words: *Pneumonia, Ventilator Associated, Klebsiella spp. Staphylococcus aureus*

INTRODUCTION

The incidence of pneumonia has been known to be higher in ICU patients than in general ward patients, and even 3-10 folds higher in patients who underwent mechanical ventilation[1]. Common causative pathogens of VAP include Gramnegative bacteria such as Pseudomonas aeruginosa, Escherichia coli, Klebsiella pneumoniae, Acinetobacter species, and Gram-positive bacteria such as Staphylococcus aureus[2]. As studies on VAP both in India and world-wide have showed variable results, as far as etiology and drug resistance pattern is considered, the present study was undertaken to identify the causative agents in our tertiary care referral hospital.

MATERIALS AND METHODS

1. Subjects

A total of 1200 patients were admitted to the medical and surgical intensive care units from January 2013 to December 2013 were examined. Clinical characteristics, bacterial pathogens, and resistance. The total admissions being 514 cases to the Medical ICU and 686 cases to the Surgical ICU. Of these 314 (26.16%) patients were put on Mechanical Ventilation. Out of these, 98 (31.21%) cases were clinically suspected to have developed VAP.

Pneumonia was diagnosed by chest radiograph and clinical and laboratory findings. If the patients, who had a new pulmonary infiltration, satisfied 2 or more conditions among the cases of body temperature 38.3oC or higher, purulent bronchial secretions, and a leucopenia or leukocytosis (< 4,000 or > 11,000 mm3), they were diagnosed with pneumonia. A prospective study was done enrolling 98 patients as per the inclusion criteria, and the following results were obtained. The subjects were divided into two groups according to the development time of VAP: early VAP group where VAP occurred within 5 days after mechanical ventilation and late VAP group where VAP occurred 5 days or later after mechanical ventilation.

2. Microbiologic analysis

Specimens were collected from all patients with the suspected pneumonia via Transtracheal Aspirate (TTA) or bronchoalveolar lavage (BAL). Culturing, and antibiotic susceptibility test was conducted in accordance with the CLSI[3].

RESULTS

A total of 1200 patients were admitted to the ICU during the stay period of one year. The total admissions being 514 cases to the Medical ICU and 686 cases to the Surgical ICU. Of these 314 (26.16%) patients were put on Mechanical Ventilation. Out of these, 98 (31.21%) cases were clinically suspected to have developed VAP.

Table 1: Age distribution of ICU patients with VAP

Age Group	No. of Cases	EARLY Onset		LATE Onset	
	(% Distribution)	VAP (%)	Non-VAP (%)	VAP (%)	Non-VAP (%)
0-20 yrs	7 (7.14)	2 (28.57)	Nil	4 (57.14)	1 (14.28)
21-40 yrs	25 (25.51)	8 (32.00)	4 (16.00)	8 (32.00)	5 (20.00)
41-60 yrs	41 (41.83)	11(26.82)	4 (9.75)	20 (48.78)	6 (14.63)
61-80 yrs	24 (24.48)	4 (16.66)	6 (25.00)	11 (45.83)	3 (12.50)
>80 yrs	1 (1.02)	Nil	1 (100)	Nil	Nil
Total (% Distribution)	**98 (100)**	**25 (36.76)**	**15 (50)**	**43 (63.23)**	**15 (50)**

A significant peak incidence of 41.83% was seen in the age group of 41-60 years. The ages of the patients ranged between 18 years and 86 years. 64.7 % of VAP patients were males and 35.3 % were females.
43 (63.23%) patients developed Late-onset VAP and 25 (36.76%) developed Early-onset VAP.
Of the total 98 patients suspected to have VAP, 68 (69.8%) developed true VAP as per the diagnostic criteria. So the Incidence Rate of VAP was calculated as given below-
Incidence Rate of VAP = 68 ÷ 314 = 21.65 per 1000 ventilator days.
Therefore, Prevalence of VAP = Incidence x Duration
= 21.65 x 1 year
= 21.65 %
In our study late onset pneumonia was more frequent (i.e. 63.23%) than early onset pneumonia (36.76%).

Table 2: Sex distribution of VAP

Sex	VAP N= 68 (%)	Non-VAP N=30 (%)	Total Cases N=98 (%)
Males	44 (64.70)	18 (60)	62 (63.26)
Females	24 (35.29)	12 (40)	36 (36.73)

62 (63.26%) of the total 98 suspected VAP patients on mechanical ventilation were males and 36 (36.73%) were females. 64.7% of the true VAP cases were males and 35.3% were females.

Table 3: Mortality Distribution

Sex	Early VAP Expired N=8 (%)	Late VAP Expired N=12 (%)	Total Mortality N=20 (%)
Males	7 (87.5)	10 (83.3)	17 (85)
Females	1 (12.5)	2 (16.7)	3 (15)

Deaths were more common in the early onset VAP cases (87.5%) amongst the male patients compared to late onset cases (12.5%).
Overall mortality was found to be 28.57% with a mortality of 29.41% in true-VAP cases.

Risk Factor Distribution
Significant risk factors in this study were–
Advancing age (41.83%), post-surgical status (16.32%), cerebrovascular disease (15.30%), chronic renal failure (15.30%), Ischemic heart disease (13.26%), Organophosphorous poisoning (11.22%)

Table 4: Distribution of Quantitative Culture reports

S. No.	Culture Report	No. of cases	%
1	No. of Bacterial Growth	19	19.38
2	Insignificant Growth ($<10^5$ Cfu/ml)	10	10.2
3	Significant Growth	68	69.38
4	Others (Candida albicans)	1	1.02

56 out of the 68 cases i.e. 80.88% had monomicrobial bacterial growth; 13 (19.11%) cases showed polymicrobial growth and 29 cases had no significant growth on culture.

Table 5: Distribution of most common bacterial isolates

Sl. No.	Organism	No. of Cases	Percentage %
1	Klebsiella spp.	20	23.80
2	Escherichia coli	18	21.42
3	Staphylococcus aureus	13	15.47
4	Pseudomonas	12	14.28
5	Acinetobacter	11	13.09
6	Citrobacter	7	8.33
7	Enterococcus	1	1.19
8	Proteus	1	1.19
9	Serratia	1	1.19
		84	100

Klebsiella (23.80%) was the most common isolate that was identified. The other significant Gram negative isolates implicated were *E. coli, Pseudomonas aeruginosa, Acenitobacter baumanii.* Amongst the gram positive isolates *Staphylococcus aureus* (15.47%) was most frequently isolated.

Table 6: Frequency of organism distribution in Early & Late VAP:

Sl. No.	EARLY-VAP (N=26)			LATE-VAP (N=58)		
	ISOLATE	**No.**	**%**	**ISOLATE**	**No.**	**%**
1	**Klebsiella**	**9**	**34.62**	**1. Escherichia coli**	**14**	**24.14**
	Klebsiella pneumoniae	6	23.07			
	Klebsiella oxytoca	3	11.53			
2	**Escherichia coli**	**4**	**15.38**	**2. Klebsiella pneumoniae**	**11**	**18.97**
3	**Citrobacter**	**3**	**11.54**	**3. Staphylococcus**	**10**	**17.24**
	Citrobacter freundii	2	7.69	Staphylococcus aureus	6	10.34
	Citrobacter koseri	1	3.84	CoNS	4	6.89
4	**Pseudomonas aeruginosa**	**3**	**11.54**	**4. Pseudomonas aerugniosa**	**9**	**15.51**
5	**Staphylococcus**	**3**	**11.54**	**5. Acenitobacter baumanii**	**9**	**15.51**
	Staphylococcus aureus	1				
	CoNS	2				
6	**Acenitobacter baumanii**	**2**	**7.69**	**6. Citrobacter freundii**	**4**	**6.89**
7	**Serratia marcescens**	**1**	**3.85**	**7. Proteus mirabilis**	**1**	**1.72**
8	**Enterococcus faecalis**	**1**	**3.85**			

Klebsiella pneumoniae (23.07%) was most frequent in early-VAP cases whereas *Escherichia coli* (24.14%) in late-VAP cases.

Table 7: Distribution of Methicillin and Vancomycin resistance amongst Staphylococcus isolates

	Total Isolates	MR	MS	R (%)	Total Isolates	VR	VS	R (%)
Staphylococcus aureus	7	5	2	(71.43)	7	-	7	(0)
Coagulase negative staphylococcus	6	6	-	(100)	6	4	2	(66.66)

71.42% of the Staphylococcus aureus isolates were Methicillin resistant compared to 100% resistance in Coagulase negative Staphylococci.

Table 8: Distribution of various β-Lactamases in Endotracheal aspirates:

Sl. No.	Organism	Total MDR Isolates	ESBL (%)	AmpC (%)	MBL (%)	E + A (%)	E +M (%)	A + M (%)
1	Klebsiella	19	6 (31.57)	2 (10.52)	-	9 (47.36)	2 (10.52)	-
2	Escherichia	17	7 (41.17)	2 (11.76)	1 (5.88)	7 (41.17)	-	-
3	Citrobacter	7	3 (42.85)	1 (14.28)	-	2 (28.57)	1 (14.28)	-
4	Proteus	1	1 (100)	-	-	-	-	-
5	Serratia	1	1 (100)	-	-	-	-	-
6	Pseudomonas	12	3 (25)	2 (16.66)	3 (25)	-	4 (33.33)	-
7	Acinetobacter	11	5 (45.45)	1 (9.09)	-	3 (27.27)	1 (9.09)	1 (9.09)
	Total	68	26 (38.23)	8 (11.76)	4 (5.88)	21 (30.88)	8 (11.76)	1 (1.47)

The distribution of pure ESBL, AmpC, metallo-beta-lactamase type of enzymes was found to be 38.23%, 11.76%, 5.88%. Co-production of ESBL-AmpC was seen in 30.88% of the isolates, whereas co-production of ESBL-MBL and AmpC-MBL enzymes was seen in 11.76% and 1.47% of the MDR Gram negative isolates.

DISCUSSION

In this study, *Klebsiella* (23.80%) was the most common isolate that was identified. The other significant Gram negative isolates implicated were *E. coli, Pseudomonas aeruginosa, Acenitobacter baumanii.* Amongst the gram positive isolates *Staphylococcus aureus* (15.47%) was most frequently isolated.

VAP is one of serious complications that occur at ICU. As its causative pathogens are antibiotic resistant in many cases, it is difficult to select appropriate antibiotics. In addition, the mortality has been reported to increase if an early antibiotic treatment is not provided to patients with VAP[4].

According to the SENTRY antimicrobial surveillance program operated in US, Europe, and South America, P. aeruginosa (27%) is the most common causative pathogen taken all regions together, and S. aureus (20%), and Acinetobacter species (14%) follow P. aeruginosa in that order[5].

Causative pathogen of VAP has been known to vary depending on the development time of VAP. In the case of early VAP that occurs within 5 days after mechanical ventilation following intubation, antibiotic sensitive bacteria such as S. aureus, Streptococcus pneumoniae, and Haemophilus influenzae are main causative pathogens. Meanwhile, in the case of late VAP that occur 5 days or later after mechanical ventilation following intubation, multidrug-resistant bacteria such as P. aeruginosa, A. baumanii, and MRSA are main causative pathogens[6,7].

In this study, *Klebsiella pneumoniae* (23.07%) was most frequent in early-VAP cases whereas *Escherichia coli* (24.14%) in late-VAP case. The recent study on nosocomial pneumonia in Asia including Korea also reported that Acinetobacter species, P. aeruginosa, S. aureus, and K. pneumoniae were the most common pathogens identified from both early and late nosocomial pneumonia[8].

VAP is a fatal disease with a high mortality. The causative pathogens of VAP may vary depending on country, region, and hospital. If information on the causative pathogens of VAP is available, it could increase the possibility of appropriate antibiotic therapy, thereby reducing the mortality and improving the prognosis. In summary, this study was conducted to investigate the causative pathogens of VAP in a tertiary referral hospital. As a result, Klebsiella spp. & S. aureus were shown to be the most common and second commonest causative pathogens of VAP, respectively.

REFERENCES

1. Safdar N, Dezfulian C, Collard HR, Saint S. Clinical and economic consequences of ventilator-associated pneumonia: a systematic review. Crit Care Med 2005;33:2184-93.
2. Jones RN. Microbial etiologies of hospital-acquired bacterial pneumonia and ventilator-associated bacterial pneumonia. Clin Infect Dis 2010;51 Suppl 1:S81-7.
3. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing: twentieth informational supplement. Document M100-S20. Wayne, PA: Clinical and Laboratory Standards Institute; 2010.
4. Luna CM, Aruj P, Niederman MS, Garzón J, Violi D, Prignoni A, et al. Appropriateness and delay to initiate therapy in ventilator-associated pneumonia. Eur Respir J 2006;27:158-64.

5. Jones RN. Microbial etiologies of hospital-acquired bacterial pneumonia and ventilator-associated bacterial pneumonia. Clin Infect Dis 2010;51 Suppl 1:S81-7.
6. Chastre J, Fagon JY. Ventilator-associated pneumonia. Am J Respir Crit Care Med 2002;165:867-903.
7. Jeon K. Ventilator-associated pneumonia. Tuberc Respir Dis 2011;70:191-8.
8. Chung DR, Song JH, Kim SH, Thamlikitkul V, Huang SG, Wang H, et al. High prevalence of multidrug-resistant non-fermenters in hospital-acquired pneumonia in Asia. Am J Respir Crit Care Med 2011;184:1409-17.