Original Research Article

Bacteriological profile with antibiogram of ventilator associated pneumonia in an intensive care unit of tertiary care hospital

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Abstract

Background: Ventilator associated Pneumonia is a common hospital acquired infection that occurs more than 48 hrs of mechanical ventilation (MV). VAP shows high incidence and mortality in ICU's and become threat to the patients undergoing treatment.**Material & Method:** A prospective study over three years included patients on Ventilator and clinically diagnosed as VAP. Quantitative cultures were made from the endotrachel aspirates, collected from the patients. The bacterial isolates were identified as per laboratory protocol. Antimicrobial detection tests were performed by the Kirby Bauer Disc Diffusion Method.**Result**: A total number of 300 Endo-tracheal (ET) secretion samples were collected from the patients with the suspected ventilator associated pneumonia and processed as per laboratory protocol. Single isolate was grown in 85% which represents the magnitude of VAP. It was observed that 112 (43.9 %) isolates were identified in early VAP patients and 143 (56.07%) isolates were identified from late VAP patients. The predominant gram negative isolate was *Acinetobacter spp.* 122 (41%) followed by *Klebsiella spp* 52 (20.39%), *Pseudomonas spp.* 47 (18.43%), *Escherichia coli* 32 (12.54%), *Enterobacter aerogens* 7 (2.74%) and *Citrobacter spp.* 5 (1.96%). Among the gram negative bacilli, 36.8% were resistant to Imipenem,, 67.8% resistant to cefoperazone- sulbactam and 87.4% resistant to Ceftazidime. All gram negative isolates were sensitive to Colistin, Polymixin B and Tigecycline.**Conclusion:** A local antibiogram pattern for each hospital is required to start empirical therapy based on bacteriological profile and susceptibility. This study may help clinicians in prescribing appropriate antimicrobials.

Keywords: Ventilator Associated Pneumonia, Mechanical Ventilation, Endotracheal Aspirates.

Introduction

Pneumonia arising in intubated and mechanical venting patients after 48 hours is known as VAP[1]. VAP is one of the most common hospital infections acquired after UTI; 86% of nosocomial pneumonia is VAP[2].VAP is generally categorized as VAP early and late onset. Early onset VAP is typically good expected and is likely to be the product of antibiotic prone entities during the first 4 days of mechanical ventilation (MV). Five (or more) days after mechanical ventilation, late onset VAP develops. It is caused by MDR pathogens and is related to patient's high mortality and morbidity[3].VAP affects in 9 to 27 percent of mechanically ventilated patients, with an average of 5 cases per 1000 ventilators. *Pseudomonas aeruginosa* and *Acinetobacter spp*. are common causes of VAP and other non-fermenter, member of Enterobacteriaceae family, *Staphylococcus* and *Candida spp*[4,5].Accurate diagnosis of VAP remains essential .Clinical diagnosis of VAP includes new or persistent infiltrate on chest radiograph with purulent tracheal secretions, blood leucocytosis or leucopenia and temperature greater than 38.3ºC[5,6].In ICUs, Mortality and morbidity are a major cause of VAP. Thus antimicrobial therapy should be started at once even if it causes a delay in diagnostic studies. Inadequate antibiotic treatment increases the incidence of MDR pathogen The aim of this study was to identify causative agents of VAP and determine their antimicrobial profile in VAP patients.

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Material & Method

300 patients on mechanical ventilation selected from different intensive care units of SMS Medical College, Jaipur (Rajasthan) over a three years from June 2017- June 2020.

Inclusion criteria for this study was patients on the mechanical ventilation for >48 hours in the ICU and all tracheal aspirate samples should be in significant number that is $>10^5$cfu/ml. Patients on mechanical ventilation for <48 hours & patients having pulmonary infiltrate prior to MV were excluded. All duplicated clinical isolates were also excluded.

VAP Diagnosis Criteria

More than 48 hours of ventilation, the existence of fever (>38.5^{0}C), white blood cell > 11,000/ml or <4000/ml, and a drop in the ratio of partial pressure to the oxygen stimulated fraction (PaO2/ FiO2 ratio) were the earliest indicators of VAP on chest X-ray. Quantitative culture of endotracheal aspirates revealed 10^5cfu/ml, confirming the diagnosis[7-9].

Collection of Endotracheal Aspirates

Collection of EA was done under aseptic precautions, using, 22 inches Ramson's 12F mucus extractor suction catheter was introduces gently through the endotracheal tube for an approximate distance of 25-26 cm. Just one ETA sample was taken, and it was analyzed as soon as it arrived in the lab[10]

Quantitative Culture

Samples for one minute homogenized by vortexing and prepare dilutions in 0.9 percent sterile normal saline solution, in a range of the 10^{-2}, 10^{-3} & 10^{-4} and were inoculated with Blood Agar (BA) and MacConkey Agar (MA). All plates were incubated overnight at 37°C and observed for growth after 24 hr. A quantitative culture threshold[11] of 10^5cfu/ml was taken into account for the definitive diagnosis of VAP in this study. Colonization is considered for the growth of any organism below the threshold.

Antimicrobial susceptibility Testing

Kirbey Bauer Disk Diffusion Method conducted the susceptibility test and the findings were interpreted in accordance with CLSI guidelines[12]

Results

Out of 300 endotracheal samples, 255 (85%) were found to have significant growth. 165 (64.70%) were male and 90 (35.29%) were female. 112 isolates (43.9%) were identified in early VAP patients and 143 (56.07%) were identified as late VAP patients. Maximum isolates were of *Acinetobacter spp*. 122 (41%) followed by *Klebsiella spp* 52 (20.39%), *Pseudomonas spp.* 47 (18.43%), *Escherichia coli* 32 (12.54%), *Enterobacter aerogens* 7 (2.74%) and *Citrobacter spp*. 5 (1.96%).VAP was maximum in age group 61-70 years. In present study COPD (22%) was the commonest risk factor followed by Diabetes (19.60%).

Table 1: Distribution of Organisms among VAP cases

Organism	No. of Cases
Acinetobacter spp.	122 (43.92%)
Klebsiella Spp.	52 (20.39%)
Pseudomonas aeruginosa	47 (18.43%)
Escherichia coli	32 (12.54%)
Enterobacter aerogens	7 (2.74%)
Citrobacter spp.	3 (1.17%)

Table 2: Risk Factors associated with VAP

Risk Factors	Patient No. (n=255)
COPD	58 (22%)
Diabetes	50 (19.60%)
PUO	45 (17.64%)
Chronic Lung Disease	39 (15.29%)
Cardio Vascular Disease	35(13.75%)
Chronic Kidney Disease	18 (7.05%)
Unknown Poisoning	10 (3.92%)

Table 3: Antibiotic resistance pattern of all isolates

Antibotic	Acinetobacter spp. (112)	Klebsiella spp.(52)	Pseudomonas aeruginosa (47)	Escherichia coli (32)	Enterobacter aerogens (7)	Citrobacter spp (5)
Cefotaxime	110 (98%)	41 (78%)	NT	30 (93%)	5 (71%)	2 (40%)
Ceftazidime	109 (97%)	42 (80%)	36 (76%)	29 (90%)	5 (71%)	2 (40%)
Cefepime	110 (98%)	45(86%)	35 (74%)	28 (87%)	5 (71%)	2 (40%)
Ciprofloxacin	102 (91%)	41 (78%)	40 (85%)	30 (93%)	6 (85%)	5 (100%)
Gentamycin	100 (89%)	42 (80%)	40 (85%)	27 (84%)	4 (57%)	2 (40%)
Doxycycline	89 (79%)	40 (76%)	35 (74%)	25 (78%)	4 (57%)	2 (40%)
Amikacin	82 (73%)	37 (71%)	32 (68%)	26 (81%)	5 (71%)	5 (100%)
Imiepenem	50 (44.64%)	20 (38%)	19 (40%)	5 (15%)	0 (0.00%)	0 (0.00%)
Pipercilline - Tazobactam	110 (98%)	41 (78%)	34 (72%)	15 (46%)	3 (42%)	1 (20%)
Cefoperazone Sulbactam	85 (75%)	34 (65%)	30 (63%)	20 (62%)	3 (42%)	1 (20%)
Polymixin B	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Colistin	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Tigecycline	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)

All gram negative isolates were highly resistant to Cefotaxime (90.03%), Ceftazidime (87.4%), Cefepime (85.5%), Ciprofloxacin (85.8%) , Doxycycline (76.4%) and Amikacin (71.3%) moderately resistant to Imipenem (36.8%) and Cefoperazone sulbactam (67.8%) and 100% sensitive to Polymixin B, Tigecycline and Colistin.

Acinetobacter spp. was more common among the other isolates showing high resistance to Cefotaxime (98%), Ceftazidime (97%), Cefepime (98%), Ciprofloxacin (91%) and Gentamicin (89%), moderate resistance to Imipenem (44.64%) and 100% sensitive to Polymixin B, Tigecycline and colistin.

Discussion

VAP is one of the most common nosocomial infections in ICU-patients following by MV. The incidence, etiology and susceptibility pattern of VAP differ between hospitals and as well as in the ICU in a same hospital. Changes in the distribution of pathogens and their susceptibility make their therapy and treatment for the patient's difficult[13].

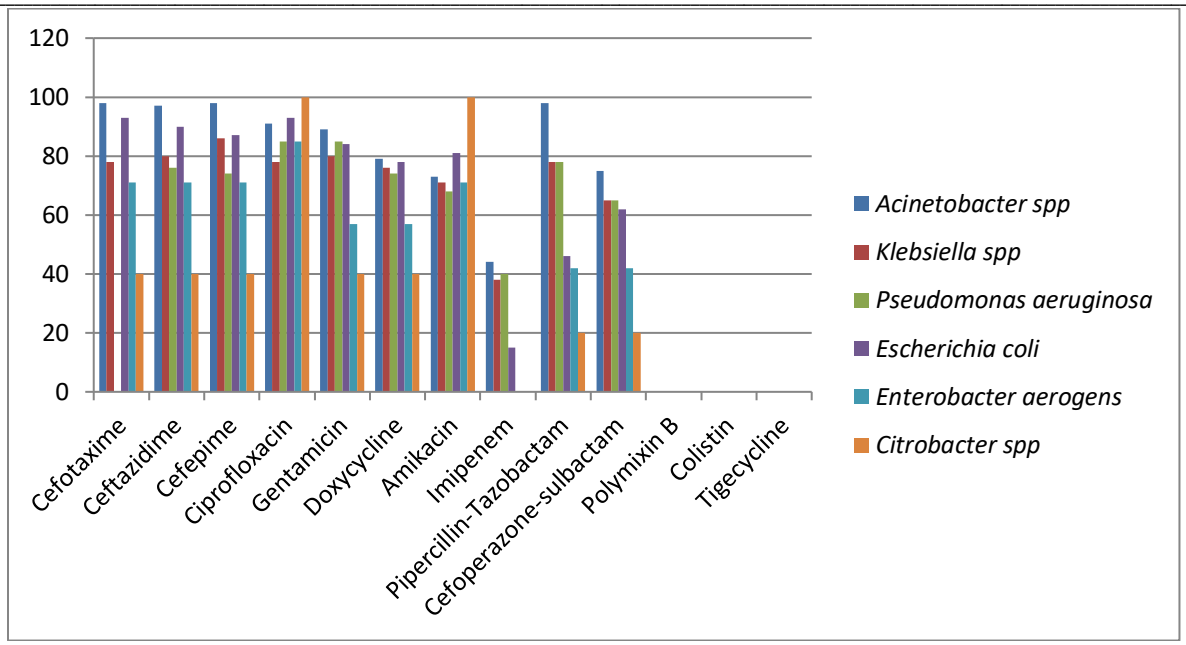

Fig1: Antibiotic Resistance Pattern of all isolates

In present study VAP was found more common in 165 (64.70%) male patients as compared to female patients 90 (35.29%). Our study in Concordance with Rana et al[14] (66.7% Male and 33.33% Female), Samal et al[15] (54% Male and 46% Female) and Daef et al[16] (65.71% Male and 34.21% Female). It was observed that 112 isolates (43.9%) were identified in early VAP patients and 143 (56.07%) were identified from late VAP patients. Similar findings were observed in Verma et al[17] (43.66% EVAP and 56.33% LVAP), Sharma et al[18] (40% EVAP and 60% LVAP) and N.M Joseph et al[19] (41.7% EVAP and 58.3% LVAP). VAP was more common in age group 61- 70 years in present study. Similar findings were observed by Patel et al [20] (61-70 years). Present study observed most common risk factor was Chronic obstructive pulmonary disorder COPD 52 (22%) followed by Diabetes (19.60%). Our result in concordance with the study of Verma et al[17] and Shete et al[21], who observed COPD in 22.22% and 57% cases respectively. *Acinetobacter spp.* (41%) was most common organism found in our study. Our result in concordance with Verma et al (41.18%)[17], Shreshta RK et al[22] (43.47%) and Nidhi Goel et al[23] (36.82%). *Acinetobacter spp*. has expected to survive in the hospital environment and this nosocomial infection acquired through cross transmission. Published evidence from the studies revealed that *Acinetobacter spp.* could live long on an inanimate entity[19].In this study most effective antibiotic was Polymixin B, Tigecycline and Colistin which had 100% sensitivity. Similarities found in study by Rit et al[2] colistin was found most effective drug. In present study all gram negative bacilli were highly resistance to Cephalosporins (Cefotaxime 90.34%, Ceftazidime 88.62%, Cefepime 88.23%), fluroquinilones (Ciprofloxacin 87.84%) and aminoglycosides (Gentamicin 84.31%, Doxycyxline 76.47%, Amikacin73.33%). Our results in concordance with Samal et al[15] and Jethwani et al[24].Imipenem resistance was high in this study as 44% in *Acinetobacter spp* followed by *Pseudomonas aeruginosa* (40%). Similar results were reported by Goel[1]et al where imipenem resistance in *Acineobacter spp* 44.44% and in *Pseudomonas aeruginosa* 47.06%.The most common etiological agent was *Acinetobacter spp*. showed high resistance to Ceftazidime (97%), Cefotaxime (98%), Cefepime (98%), Ciprofloxacin (91%), Gentamicin (89%), Doxycycline (79%), Amikacin (73%), Pipercilline –Tazobactam (98%) , Cefaperazone-Sulbactam (75%) , Moderately resistance to Imepenem (44.64%) and highly sensitive to Colistin, Polymixin B and Tigecycline (100% sensitive). Our results in concordance with the study of Goel et al[1] (Ceftazidime, Cefepime, Cefotxime, Ciprofloxacin, Gentamycin, Doxycycline (100%) Amikacin (99.6%), Pipercilline-Tazobactam (98.5%), Imipenem (44%), Polymyxin B (0%) and Colistin (0%)).In contrast with other gram-negative bacteria, the above antimicrobial resistance pattern specifically illustrated the rising resistance of *Acinetobacter spp*. to different antibiotics. Colistin, Polymixin B and Tigecycline are the drug of choice which is active against *Acinetobacter spp*.

Conclusion

In conclusion the present study showed the most common isolate from endotracheal aspirate was *Acintobacter spp* followed by *Klebsiella spp* and *Pseudomonas aeruginosa*. The occurrence of VAP most common in age group >60 years due to duration of stay in ICU gradually increases with increases age. Multidrug Resistance (MDR) microorganisms persistence impaired treatment responses were more common among the VAP patients. Combined rotations, hand washing and decontamination methods can also be helpful if these MDR pathogenic products are combined, which can reduce the occurrence of VAP.

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