

## Original Research Article

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## Microbiological Profile of Ventilator Associated Pneumonia (VAP) in Geriatric Patients and their Antibiotic Susceptibility Pattern with Detection of MRSA, ESBLs and MBLs in Intensive Care Unit of a Tertiary Care Centre from South India

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### ABSTRACT

Ventilator Associated Pneumonia (VAP) is defined as pneumonia that occurs 48 hours or more after endotracheal intubation or tracheostomy, caused by infectious agents not present or incubating at the time mechanical ventilation started. While critically ill patients experience a life-threatening illness, they commonly contract ventilator-associated pneumonia. This nosocomial infection increases morbidity and likely mortality as well as the cost of health care. This study aims to find out the bacterial profile of VAP in geriatric patients and the antibiotic susceptibility pattern of the isolated pathogen including detection of MRSA, ESBLs and MBLs. This study was conducted in the Department of Microbiology at ESIC MC and PGIMSR, Rajajinagar, Bengaluru from January 2017 to June 2018. A total of 38 isolates from 35 VAP patients were collected during the study. They were processed following standard laboratory protocol. Antibiogram was done using appropriate antibiotics by Kirby-Bauer disc diffusion method and the occurrence of MRSA, ESBLs and MBLs was seen. Males were most common male to female ratio of 2:1. *Acinetobacter spp.* (45.5%) was most common organism isolated followed by *Pseudomonas aeruginosa* (24.2%), *Klebsiella pneumoniae* (21.2%), *Staphylococcus aureus* (15.2%) and *Escherichia coli* (9%). Enterobacteriaceae isolated were found to be highly sensitive to Amikacin (30%) followed by Gentamicin (20%) and Piperacillin-tazobactam (10%) and Highest resistance (100%) was seen with Cefotaxime, Cefoperazone, Cotrimaxazole, Piperacillin and Amoxiclav. Non-fermenters showed highest sensitivity to Cefperazone-sulbactam (73.9%), followed by Amikacin (60.9%) and Meropenem (52.2%). Highest resistance was seen with Cefotaxime (86.9%) followed by Cefperazone (78.3%) and Ceftazidime (73.9%). Overall MDR among Gram negative isolates were 31.6% and common mechanism of resistance was found to be Carbapenamase (57.6%), followed by AmpC (18.2%), and ESBL (3.03%). Among Carbapenamase Metallo-betalactamase production was seen in 18.2% of isolates. MRSA was detected to be 40% and were sensitive to Linezolid, Tetracycline and Teicoplanin. Diabetes mellitus (54.3%) was most common risk factor, followed by smoking (51.4%), and alcohol (45.7%). 88% of patients had leucocytosis with mean total leucocytosis count (TLC) of 17,348 cells/mm<sup>3</sup> and 17% of patients were anaemic with mean Hb of 10.02g/dl and 45.7% of patients had pneumonic changes (consolidation) and 51.4% of patients had BL/UL alveolar or interstitial infiltration. Periodic analysis of Sputum culture and their antibiotic sensitivity report should be made to identify the changing trends in etiological and sensitivity patterns.

#### Keywords

Ventilator associated pneumonia, Multidrug resistant, Geriatric VAP, Extended Spectrum  $\beta$ -lactamases, Metallobetalactamases, Methicillin Resistant *Staphylococcus aureus*

#### Article Info

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## **Introduction**

Ventilator-associated pneumonia (VAP) is one of the most dreaded nosocomial infection and a major threat for the older population, as they have age related immunological changes, chronic cognitive and physical impairment and alter host resistance, and therefore they are highly susceptible to infections and their complications.<sup>1</sup> Acute Lower respiratory tract infections such as pneumonia, acute bronchitis and Acute exacerbations of Chronic Obstructive Pulmonary Disease (COPD) are among the most common reasons to visit a general practitioner (GP), notably among elderly person.<sup>2</sup> LRTI (along with pneumonia) a disease of developing countries, have an incidence of about 20%-30% in developing countries like India as compared to 3%-4% in developed countries.<sup>3</sup> According to the global burden of Disease 2015 study (GBD 2015), COPD and Lower Respiratory Tract Infection represents the 3rd and 4th most common cause of death respectively after ischemic heart disease and cerebrovascular disease.<sup>4</sup>

In critically ill patients, the susceptibility of the bacteria isolated in a VAP depends on the duration of stay in the ICU and on mechanical ventilation as well as the previous use of antibiotics.<sup>5</sup> Diagnosing of VAP is difficult as it requires a thorough assessment of clinical findings, radiological findings, and microbiological results. There are no fool proof tools to determine whether the patient has a VAP. When the clinical suspicion of VAP is high, empirical antimicrobial therapy must be initiated promptly because both delayed and inadequate treatments have been associated with increased rate of morbidity and mortality.<sup>6</sup> In patients with no signs of severe sepsis or septic shock and no organisms present on Gram's staining, antimicrobial therapy can be withheld pending culture results.<sup>7,8</sup> Nevertheless, one

third of the patients with VAP only exhibit clinical criteria of sepsis.<sup>9</sup> Current guidelines recommend empirical coverage of Gram-negative bacilli (GNB) with a third or fourth generation cephalosporin, piperacillin-tazobactam or a carbapenem in combination with a fluoroquinolone or an aminoglycoside.<sup>10</sup> However, the problem arises when a high proportion of the GNB are resistant to these antibiotics.

The ageing population has both medical and sociological problems. Ageing in India is exponentially increasing due to the impressive gains that society has made in terms of increased life expectancy including the advances in antibiotic therapy. The elderly population suffers high rates of morbidity and mortality due to infectious diseases.<sup>11</sup> After a period of neglect, this problem is now receiving the deserved attention of the medical community.<sup>12</sup> Infectious disease account for one third of all deaths in elderly age group.<sup>9,13</sup> The impact of infectious disease particularly in the ageing population should not be measured only in terms of mortality rate, but also by morbidity and quality of life.<sup>12</sup>

The bacteriological profile of the LRTIs are different in different countries, and also vary with time within the same country, the aetiology of respiratory infections play a significant role in the choice of empirical antibiotics, isolation and hospitalization measures.<sup>14,15,16</sup>

The recent advances in medical technologies, usage of mechanical ventilator and other procedures like bronchoscopes, prior antibiotic prescription even before the availability of culture results and frequent admission to hospital lead to the bacterial colonization and infection.<sup>17</sup> With the emergence of antibiotic resistant bacteria, the role that hospitals play in the development

and spread of organisms becomes an important factor for investigation.

## **Materials and Methods**

This descriptive study was conducted for a period of 1 year from January to December 2018 at a tertiary care hospital, Bangalore, after obtaining due approval from the Institutional ethics committee.

### **Source of data**

Lower respiratory tract samples of elderly patients like Broncho-alveolar lavage (BAL) and Endo Tracheal Aspirate submitted to diagnostic Microbiology laboratory ESIC MC & PGIMSIR will be included

### **Inclusion criteria**

Lower respiratory tract samples like BAL & ET Aspirate of patients aged 60 years or above.

### **Exclusion criteria**

Patient on chronic suppressive antimicrobial therapy.

Patient diagnosed as pulmonary tuberculosis

Patient diagnosed as Retro positive.

Informed consent was obtained from the patients and strict confidentiality about the patient details was maintained.

## **Laboratory methodology**

### **Collection of ET Aspirate<sup>18,19</sup>**

12 French (Fr) tracheal aspiration probe was introduced through the ETT until resistance encountered (level of the carina in the trachea) and retracted approximately 2cm to release of the vacuum and probe delicately removed using turning movements and secretions aspirated into sterile collector tube.

### **Collection of BAL<sup>18,19</sup>**

High volume of saline (100 to 300 mL) was infused into a lung segment through the bronchoscope to obtain cells and protein of the pulmonary interstitium and alveolar spaces. A deep sampling of desquamated host cells and secretions was collected.

### **Processing of samples<sup>20</sup>**

Tracheal aspirate/ BAL - Most purulent portion of tracheal secretion was taken, 0.1 ml sample was diluted in 9.9 ml sterile physiological solution. 0.01 ml was seeded (calibrated loop) on MacConkey agar, blood agar & chocolate agar and Incubation at  $35 \pm 1^\circ\text{C}$  for 24 to 48h, (chocolate agar, in capnophilia (5% of  $\text{CO}_2$ ) at  $35 \pm 1^\circ\text{C}$  for 24 to 48h). Plates were evaluated for growth at 24 and 48hours. Bacterial isolates grown in culture were identified by means of Gram's staining and biochemical reactions by standard microbiological techniques. Each colony corresponded to 20,000CFU/ml and it was considered ETA positive when the count was  $\geq 10^5$ CFU/ml.

### **Antimicrobial susceptibility testing**

Antibiotic susceptibility tests were done against antibiotics by using Standard Kirby Bauer disk diffusion method in accordance with Clinical and Laboratory Standards Institute (CLSI) criteria. Every batch of Mueller-Hilton agar and antibiotic discs were tested by using following control strains: ATCC 25922 *Escherichia coli*, ATCC 27853 *Pseudomonas aeruginosa* and ATCC 25923 *Staphylococcus aureus*.

### **Detection of resistance mechanisms**

Methicillin Resistant *Staphylococcal aureus* (MRSA) was detected by Cefoxitin disk diffusion test

Extended Spectrum  $\beta$ -Lactamase (ESBL) was detected by phenotypic disc confirmatory test

AmpC  $\beta$ -Lactamase was detected by AmpC Disk test

Carbapenamase and Metallo- $\beta$  Lactase (MBL) was detected by Modified Carba NP test and EDTA synergy test respectively

Inducible and constitutive MSBL resistant by D-zone disk diffusion test

### **Tests to detect methicillin resistant *Staphylococcus aureus* (MRSA)**

#### **Cefoxitin disc (30ug) diffusion test**

The test is performed with 30 $\mu$ g of cefoxitin per disc placed on 25ml Mueller Hinton agar plate. The zone of inhibition is determined after 24 hrs of incubation at 37°C. The zone size is interpreted according to CLSI guidelines.

Susceptible >22mm

Resistant  $\leq$  21mm

#### **Quality control used for MRSA detection**

ATCC *S. aureus* 43300 (positive control)

ATCC *S. aureus* 25923 (negative control)

#### **Detection of inducible clindamycin resistance<sup>21</sup>**

Disk Diffusion: (D-zone test): (*Staph. aureus*, *Staph. lugdunensis*, CONS, *Strep. pneumoniae* and  $\beta$ -hemolytic *Streptococcus* spp.) Using Standard disk diffusion procedure with 15 $\mu$ g erythromycin and 2 $\mu$ g clindamycin disks spaced 15-26 mm apart (12mm apart for *S. pneumoniae* and  $\beta$ -hemolytic *Streptococcus* spp.) Flattening of the zone of inhibition adjacent to the erythromycin disk (D-zone) is inducible clindamycin resistance. And hazy

growth within the zone of inhibition around clindamycin is also taken as clindamycin resistance.

#### **Detection of ESBL by Disk diffusion test (DDT)<sup>21</sup>**

Cefotaxime (30 $\mu$ g) or ceftazidime disks (30 $\mu$ g) with and without clavulanate (10 $\mu$ g) are used. A difference of  $\geq$ 5mm between the zone diameters of either of the cephalosporin disks and their respective cephalosporin/clavulanate disk was taken to be phenotypic confirmation of ESBL production.<sup>20</sup> The CLSI recommends that the disk tests be performed with confluent growth on Mueller-Hinton agar.

#### **Modified Amp C Disc method<sup>21</sup>**

Briefly, 0.5 McFarland suspension of *Escherichia coli* ATCC 25922 was inoculated on the surface of MHA plate. A 30 $\mu$ g cefoxitin disk & a sterile plain disk inoculated with several colonies of the test organism was placed just beside the cefoxitin disk almost touching it, with inoculated disk face in contact with the agar surface. After overnight incubation at 37°C, the plates were examined for either an indentation or a flattening of the zone of inhibition, indicating enzymatic inactivation of cefoxitin (positive result), or absence of a distortion (negative result).

#### **Carba NP (CNP) test**

CNP A solution was prepared by adding phenol red (0.05%) and ZnSO<sub>4</sub>.7H<sub>2</sub>O (0.1 mmol/L) to Clinical Laboratory Reagent Water; pH was adjusted to 7.8  $\pm$  0.1, and the solution was stored at 4°C in amber-coloured bottles for up to 15 days. The B solution was freshly prepared by adding 12 mg/ml imipenem- cilastatin injectable form (doubling the amount to compensate the cilastatin component; equivalent to 6 mg/ml

of imipenem standard grade powder) to A solution and stored at 40C till use. Two calibrated loops (10µl) of bacterial colony from 18 to 24 h growth culture from sheep blood agar were resuspended in 200µl of 5 M NaCl solution and vortexed for 5 seconds. A 100µl of inoculum was added to two microcentrifuge tubes labelled “a” and “b.” Reagents A and B were added to tubes a and b, respectively, incubated at 37°C and read at 2hours. The test was considered positive when tube “a” was red and tube “b” was orange/yellow. In a negative test, both tubes remained red.<sup>68</sup>

### **Detection of Metallo beta lactamase**

Combined disk synergy test (CDST) with 0.5 M ethylene diamine tetra acetic acid Two IPM (10µg) disks were placed 30 mm apart from centre to center on the surface of an agar plate, and 10µl 0.5 M EDTA solution was added to one of them to obtain the desired concentration of 750µg. If zone of inhibition of IPM-EDTA disk was  $\geq 7$  mm more than that of IPM disk alone, it was considered as MBL positive.<sup>69</sup>

### **Results and Discussion**

A total number of 35 patients who developed VAP were included. Among 35 patients, predominant were males accounting for 68.6% in which 63.3% were between 60-79 years and 31.4% were females among which 36.7% were between 60 and 79 years (Table 1).

### **Distribution of pure and mixed culture (n=35)**

Among the 38 culture positive tracheal aspirate and BAL fluid, 35 (91.4%) yielded pure bacterial (mono-microbial) isolates and 3(8.6%) yielded mixed infection (two organisms- polymicrobial); hence a total

number of 38 organisms were isolated out of 35 samples (Figure-1).

Most common organism isolated was *Acinetobacter* spp., (39.47%), followed by *Pseudomonas aeruginosa* (21%), *Klebsiella pneumoniae* (18.4%), *Staphylococcus aureus* (13.2%) and *Escherichia coli* (7.9%). All the isolates were common in age group of 60-79yrs.(Table-3)

### **Ward wise distribution of inpatients**

Among 35 patients, 28 (80%) were from ICU and 7 (20%) were from Medicine.

### **Antibiotic Resistance pattern of Gram negative bacilli**

Resistance to third generation Cephalosporins among enterobacteriaceae ranged from 90%-100%. Highest sensitivity was seen to Amikacin (30%), followed by Gentamicin (20%), Piperacillin-tazobactam (10%), Cefoperazone-sulbactam (10%), Astreonom (10%), Imepenem (10%) and Meropenem (10%).

Among non-fermenters, third generation cephalosporin resistance ranged from 26.1%-86.9%. Highest resistance was seen in Cefotaxime (86.9%) followed by Cefoperazone (78.3%) and Astreonom (73.9%).

### **Distribution of MDR phenotypes among tracheal aspirate & BAL**

Among Enterobacteriaceae, 71.4% of *Klebsiella pneumoniae* and 66.7% of *Escherichia coli* were MDR and in non-enterobacteriaceae 40% of *Acinetobacter* spp., and 25% *Pseudomonas aeruginosa* were MDR. Overall MDR among Gram negative isolates were 45.5%.

**Comparison of Antibiotic Resistance among Gram negative isolates**

For MDR isolates most sensitive drug was Cefoperazone-sulbactam (25%), followed by Piperacillin-tazobactam (8.3%), Piperacillin (8.3%) and Cefoperazone (8.3%).

Whereas in non-MDR isolates Amikacin (77.7%) was most sensitive followed by Cefoperazone-sulbactam and Gentamicin (72.2% each).

**Beta lactamase production among Gram negative isolates**

Most common mechanism of resistance among isolates was found to be Carbapenemase production (57.6%) {9 by *Acinetobacter spp.*, 6 by *Klebsiella pneumoniae*, 2 each by *Pseudomonas aeruginosa* and *Escherichia coli*}, followed

by AmpC (18.2%) {4-*Klebsiella pneumoniae* & 2-*Escherichia coli*}, and ESBL (3.3%) by *Klebsiella pneumoniae*. Among carbapenemase Metallo-betalactamase production was seen in 31.6% of isolates.

**Correlation with MDR and Carbapenemase among *Acinetobacter spp.*,**

60% of the isolated *Acinetobacter* species were Carbapenemase producers among which, 55.55% were MDR+

**Correlation with MDR and Carbapenemase among *Pseudomonas aeruginosa***

25% of the isolated *Pseudomonas* were Carbapenemase producers and among which 12.5% were MDR+

**Table.1** Age and Sex wise distribution of VAP

Age group	Female	Male
60-79 (n=30)	11 (36.7%)	19 (63.3%)
≥80 (n=5)	0	5 (100%)
<b>Total (n=35)</b>	11	24

**Table.2** Distribution of isolates according to age

Organism	Age group		Total	Sex		Total
	60-79yrs	≥ 80yrs		Male	Female	
<i>Acinetobacter spp.</i>	15	0	15	10	5	15
<i>Pseudomonas aeruginosa</i>	7	1	8	5	3	8
<i>Klebsiella pneumoniae</i>	5	2	7	6	1	7
<i>Staphylococcus aureus</i>	4	1	5	3	2	5
<i>Escherichia coli</i>	2	1	3	3	0	3
<b>Total</b>	33	5	38	27	11	38

**Table.3** Distribution of Polymicrobial isolates

Organism	No	Age	Sex
<i>Acinetobacter spp+ Staphylococcus aureus</i>	1	80	M
<i>Pseudomonas aeruginosa+Staphylococcus aureus</i>	1	72	F
<i>Acinetobacter spp+ Escherichia coli</i>	1	68	F
<b>Total</b>	3		

**Table.4** Ward wise distribution of inpatients (n=35)

Ward	No of patients	Percentage (%)
ICU	28	80
Medicine	7	20
<b>Total</b>	35	100

**Table.5** Antibiotic Resistance pattern of Gram negative bacilli

Antibiotics	Enterobacteriaceae		Total (n=10)	Non -Enterobacteriaceae		Total
	<i>Klebsiella pneumoniae</i> (n=7)	<i>Escherichia coli</i> (n=3)		<i>Acinetobacter spp.</i> (n=15)	<i>Pseudomonas aeruginosa</i> (n=8)	
<b>Piperacillin</b>	7 (100%)	3 (100%)	10 (100%)	12 (80%)	4 (50%)	16 (69.6%)
<b>Amoxicillin-clavulanic acid</b>		3 (100%)	3 (100%)	15 (100%)		15 (65.2%)
<b>Ciprofloxacin</b>	6 (85.7%)	3 (100%)	9 (90%)	11 (73.3%)	4 (50%)	15 (65.2%)
<b>Cefoperazone</b>	7 (100%)	3 (100%)	10 (100%)	13 (86.7%)	5 (62.5%)	18 (78.3%)
<b>Cefotaxime</b>	7 (100%)	3 (100%)	10 (100%)	13 (86.7%)	7 (87.5%)	20 (86.9%)
<b>Ceftazidime</b>	7 (100%)	3 (100%)	10 (100%)	12 (80%)	5 (62.5%)	17 (73.9%)
<b>Cotrimaxazole</b>	7 (100%)	3 (100%)	10 (100%)	12 (80%)		12 (52.2%)
<b>Piperacillin tazobactam</b>	6 (85.7%)	3 (100%)	9 (90%)	9 (60%)	1 (12.5%)	10 (43.5%)
<b>Cefperazone sulbactam</b>	6 (85.7%)	3 (100%)	9 (90%)	4 (26.7%)	2 (25%)	6 (26.1%)
<b>Aztreonem</b>	6 (85.7%)	3 (100%)	9 (90%)	12 (80%)	5 (62.5%)	17 (73.9%)
<b>Gentamycin</b>	6 (85.7%)	2 (66.7%)	8 (80%)	8 (53.3%)	4 (50%)	12 (52.2%)
<b>Imipenem</b>	6 (85.7%)	3 (100%)	9 (90%)	9 (60%)	3 (37.5%)	12 (52.2%)
<b>Amikacin</b>	5 (71.4%)	2 (66.7%)	7 (70%)	6 (40%)	3 (37.5%)	9 (39.1%)
<b>Meropenem</b>	6 (85.7%)	3 (100%)	9 (90%)	9 (60%)	2 (25%)	11 (47.8%)

**Table.6** Distribution of MDR phenotypes among tracheal aspirate & BAL

Organism	MDR	Percentage %
<i>Klebsiella pneumoniae</i> (n=7)	5	71.4
<i>Acinetobacter spp.</i> (n=15)	6	40
<i>Pseudomonas aeruginosa</i> (n=8)	2	25
<i>Escherichia coli</i> (n=3)	2	33.3
<b>Total (n=33)</b>	<b>15</b>	<b>66.7</b>

**Table.7** Comparison of Antibiotic Resistance among Gram negative isolates (n=33)

Antibiotic	MDR (n=15)	%	Non-MDR	%
<b>Piperacillin</b>	13	86.7	13	72.2
<b>Ciprofloxacin</b>	15	100	9	50
<b>Cefoperazone</b>	14	93.3	14	93.3
<b>Ceftazidime</b>	15	100	12	80
<b>Piperacillin-tazobactam</b>	12	80	7	38.9
<b>Cefperazone-sulbactam</b>	10	66.7	5	27.8
<b>Aztreonem</b>	14	93.3	12	80
<b>Gentamycin</b>	15	100	5	27.8
<b>Imipenem</b>	14	93.3	7	38.9
<b>Meropenem</b>	12	80	7	38.9
<b>Amikacin</b>	12	80	4	22.3

**Table.8** Beta lactamase production among Gram negative isolates (n=33)

Mechanism of resistance production	Frequency	Percentage (%)
<b>ESBL</b>	1	3.03
<b>Carbapenamase</b>	Metallo-βlactamase (n=6)	57.6
	Non-metallo-βlactamase (n=13)	
<b>AmpC</b>	6	18.2
<b>ESBL+AmpC</b>	1	3.03

**Table.9** Correlation with MDR and Carbapenamase among *Acinetobacter spp.*,

	MDR+	Non-MDR+	Total
<b>Carbapenamase +</b>	5	4	9 (60%)
<b>Non carbapenamase +</b>	1	5	6(40%)
<b>Total</b>	6	9	15

**Table.10** Correlation with MDR and Carbapenamase among *Pseudomonas aeruginosa*

	MDR+	Non-MDR+	Total
<b>Carbapenamase +</b>	1	1	2 (25%)
<b>Non carbapenamase +</b>	1	5	6 (75%)
<b>Total</b>	2	6	8

**Table.11** Antibiotic resistance pattern of *Staphylococcus aureus*

Antibiotic	<i>Staphylococcus aureus</i> (n=5)
<b>Amikacin</b>	1 (20%)
<b>Gentamycin</b>	3 (60%)
<b>Ciprofloxacin</b>	4 (80%)
<b>Cotrimoxazole</b>	3 (60%)
<b>Erythromycin</b>	3 (60%)
<b>Linezolid</b>	0 (0%)
<b>Teicoplanin</b>	0 (0%)
<b>Tetracyclin</b>	0 (0%)
<b>Amoxicillin-clavulanic acid</b>	5 (100%)

**Table.12** Distribution of MRSA

	No of isolates (n=5)	Percentage (%)
<b>MRSA</b>	2	40
<b>MSSA</b>	3	60
<b>Total</b>	5	100

**Table.13** Shows *Staphylococcus* strains producing iMSLB (inducible macrolide streptogramin b lincosamide resistance) and cMSLB (constitutive macrolide streptogramin b lincosamide resistance)

	No of isolates (n=5)	Percentage %
<b>iMSLB</b>	0	0
<b>cMSLB</b>	2	40
<b>Total</b>	2	

**Table.14** Risk factors associated with LRT infections (n=35)

Risk factor	No of Patients	Percentage (%)
Diabetic	19	54.3
Smoking	18	51.4
Alcohol	16	45.7
Previous COPD	12	34.3
Poor oral hygiene	10	28.5
Cardiac diseases	6	17.2
Malnutrition	4	11.4
Renal disease	3	8.5
Hemiparesis	1	2.8
CA lung	1	2.8

**Table.15** Radiological correlation (n=35)

Radiological finding	No of patients	Percentage (%)
Consolidation	16	45.7
B/L alveolar or interstitial infiltration	18	51.4
Consolidation with CA lung	1	2.8
Total	35	

**Table.16** Laboratory correlation (n=35)

Investigation	Percentage (%) or Mean
Anaemia	17%
Mean Hb	10.02g/dl
Mean TLC	17348cells/mm <sup>3</sup>
Leucocytosis	88%

**Fig.1** Distribution of pure and mixed culture



### **Antibiotic resistance pattern of *Staphylococcus aureus***

Among the 5 isolates of *Staphylococcus aureus*, maximum resistance was seen to Amoxiclav (100%) and Ciprofloxacin (80%). All the isolates were sensitive to Linezolid, Tetracycline and Teicoplanin.

### **Distribution of MRSA**

In our study, 2 were Methicillin Resistant *Staphylococcus aureus* (MRSA) accounting 40% and remaining 60% were Methicillin Sensitive *Staphylococcus aureus* (MSSA).

In our study, No iMSLB and 2 isolates were cMSLB accounting for 40%. Among the two iMSLB *Staphylococcus* strains one was MSSA and one more was MRSA.

In conclusion, VAP is one of the common infections in the geriatric age group requiring hospitalisation. The presence of multiple co-morbidities, great burden of underlying disease, declining immune status and a different response to treatment with ageing, all increase the susceptibility for Pneumonia in the elderly. Age, smoking, and underlying co-morbid conditions especially chronic obstructive pulmonary disease were significantly associated with the development of VAP. We report a high rate of resistance to common antibiotics in present study and *Acinetobacter* spp to be the most common etiological agent behind the VAP. Furthermore, high level of ESBL and carbapenamases production is of concern and monitoring of the same is necessary to prevent treatment failure and increased morbidity and mortality among VAP cases. For empirical therapy effective antibiotics found were Imipenem, Amikacin and Meropenem.

Periodic analysis and their antibiotic sensitivity report should be made so that

changing trends in the etiological and sensitivity patterns can be identified and therapy adjusted accordingly so that emergence of resistance will be prevented. Strict infection control measures should also be followed to contain hospital acquired infections.

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