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Ventilator Associated Pneumonia

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Abstract: ***Ventilator Associated Pneumonia (VAP) refers to a type of pneumonia that occurs more than 48-72 hours after end tracheal intubation .This is one of the most common nosocomial infections in ventilated individuals.[1,2] VAP occurs in 9-27%of intubated atients.[3,4] Delay in initiating appropriate antibiotic therapy can increase the mortality associated with VAP.[5,6] Initial empirical therapy can be modified based on the knowledge of local microbiological data, patient characteristics, and sensitivity pattern of expected pathogens at the institution. One of the consequences of increasing antimicrobial resistance is greater probability of inappropriate empiric antibiotic therapy.[7] The aim of this study was to find the incidence of VAP and mortality associated with it. We also aimed to find frequency of pathogens isolated from the tracheal aspirate of patients diagnosed with VAP and the correlation of pathogen with duration of ICU stay.***

Keywords: Ventilatory associated pneumonia; antibiotic sensitivity; pathogens; mortality.

1. Objectives

To find out Microbiological pattern of VAP in patients on ventilator along with Correlation of pathogen with duration of stay and mortality

a) Inclusion Criteria
Patients with VAP, more than 18yrs with consent were included

b) Exclusion Criteria
Patients having prior pneumonia and ARDS ,less than 18 yrs were excluded.

2. Methodology

a) Source of Data
Patients admitted in the critical care areas of JSS Hospital

b) Method of Collection of Data
This was a prospective cohort study done over a period of 1 year. Total of 86 who met the criteria were included. VAP was diagnosed using clinical pulmonary infection score which was evaluated on day2, 4, 7, and 10. CPIS> 6 was used diagnostic. Early onset VAP within 4 days of ventilation and late onset VAP after 4 days of ventilation. Endotracheal aspirate was preferred over protected specimen brush (PSB) sampling and bronchi-alveolar lavage(BAL), as these techniques are more invasive without mortality benefit over endotracheal aspirate

c) Endotracheal Aspirate:
Endotracheal aspirate was obtained under aseptic precautions using a 22-inch Ramson's 12F suction catheter with a mucus extractor as per standard protocol. After this, 2ml of 0.9% saline was injected into ET to flush the exudates into sterile container and immediately taken to the laboratory.

3. Statistical Methods

3.1 Descriptives

The Descriptive procedure displays univariate summary statistics for several variables in a single table and calculates standardized values (z scores). Variables can be ordered by the size of their means (in ascending or descending order), alphabetically, or by the order in which you select the variables (the default).

3.2 Crosstabs (Contingency table analysis)

The Crosstabs procedure forms two-way and multi-way tables and provides a variety of tests and measures of association for two-way tables. The structure of the table and whether categories are ordered determine what test or measure to use.

3.3 Chi square test

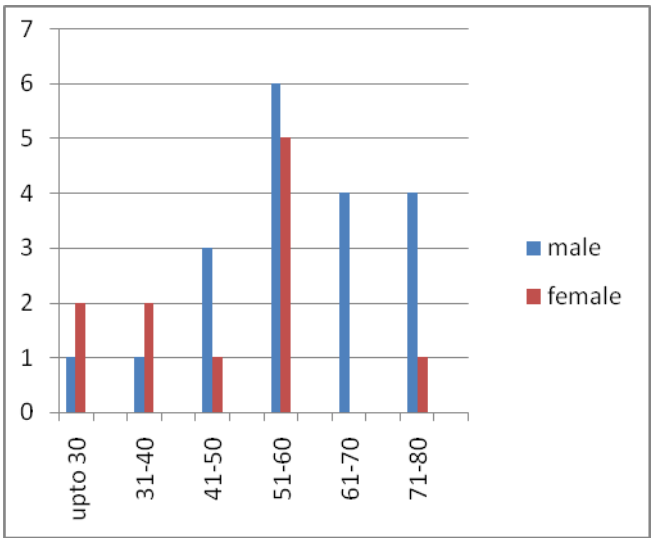
The Chi-Square Test procedure tabulates a variable into categories and computes a chi-square statistic**.** This goodness-of-fit test compares the observed and expected frequencies in each category to test either that all categories

contain the same proportion of values or that each category contains a user-specified proportion of values.

3.4 One way ANOVA and Scheffe's post hoc test

The One-Way ANOVA procedure produces a one-way analysis of variance for a quantitative dependent variable by a single factor (independent) variable. Analysis of variance is used to test the hypothesis that several means are equal. This technique is an extension of the two-sample t test.

4. Results

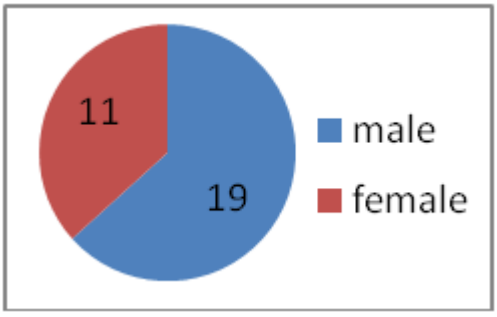


Graph 1: Demographics

The maximum number of patients were in the age group 51-60, includes a total of 11 patients (36.7), followed by 5 (16.7%) in the age group 71-80 years. From the above table and graph we infer that there is no significant relation between the development of VAP and age groups

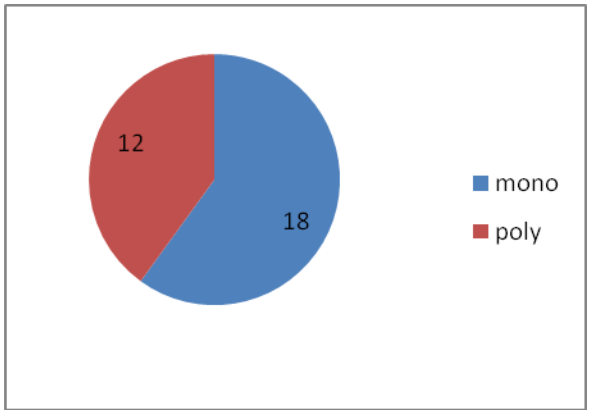
Table 2: Sex Distribution

		Frequency	Percent
Valid	Male	19	63.3
	Female	11	36.7
	Total	30	100.0



Graph 2: Sex Distribution between Patients

Out of 30 patients diagnosed with VAP, 19(63.3%) were males and 11(36.7%) were females. In this study, there was an inclination towards male gender but the difference was statistically not significant.

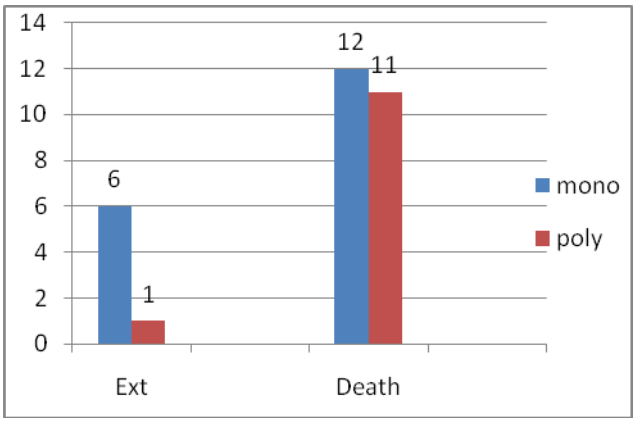


Graph 3: VAP Associated With Monomicrobials and Polymicrobials

Out of 30 with VAP, 18(60%) had monobacterial and 12(40%) polybacterial infections. In this study monomicrobial infections were more than the polymicrobials infections but no statistical significance.

Table 5: Outcomes of Patients with VAP, with Monomicrobials and Olymicrobials

			TYPE		Total
			Mono	Poly	
OUTCOME	Ext	Count	6	1	7
		% of TYPE	33.3%	8.3%	23.3%
	Death	Count	12	11	23
		% of TYPE	66.7%	91.7%	76.7%
Total		Count	18	12	30
		% of TYPE	100.0%	100.0%	100.0%

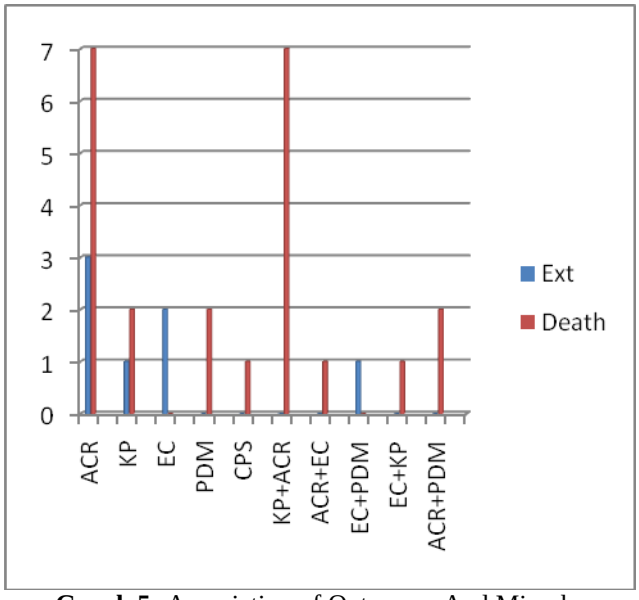


Graph 4: Outcomes of Patients with VAP, With Monomicrobials and Polymicrobials

Out of 18 patients with monomicrobial VAP, 12 (66.7%) expired where as out of 12 patients with polymicrobial VAP 11(91.7%) expired. Thus in our study the mortality was high with polymicrobial VAP.

Table 5: Outcomes of Patients with VAP, With Monomicrobials and Olymicrobials

			OUTCOME		Total
			Ext	Death	
Types	ACR	Count	3	7	10
		%of OUTCOME	42.9%	30.4%	33.3%
	KP	Count	1	2	3
		%of OUTCOME	14.3%	8.7%	10.0%
	EC	Count	2	0	2
		%of OUTCOME	28.6%	.0%	6.7%
	PDM	Count	0	2	2
		%of OUTCOME	.0%	8.7%	6.7%
	CPS	Count	0	1	1
		%of OUTCOME	.0%	4.3%	3.3%
	KP+ACR	Count	0	7	7
		%of OUTCOME	.0%	30.4%	23.3%
	ACR+EC	Count	0	1	1
		%of OUTCOME	.0%	4.3%	3.3%
	EC+PDM	Count	1	0	1
		%of OUTCOME	14.3%	.0%	3.3%
	EC+KP	Count	0	1	1
		%of OUTCOME	.0%	4.3%	3.3%
	ACR+PDM	Count	0	2	2
		%of OUTCOME	.0%	8.7%	6.7%
Total		Count	7	23	30
		%of OUTCOME	100.0%	100.0%	100.0%



Graph 5: Association of Outcomes And Microbes

A. Pattern of monomicrobial infection and its outcome

Out of 18 patients who developed monomicrobial VAP, the commonest organism isolated was A. baumannii amounting to10 (55.5%) followed by Klebsiella pneumonia 3(16.67%), E.coli2 (11.11%), P.aeruginosa2 (11.11%), coagulase positive S.aureus 1(5.55%). Of the 10 patients with Acinetobacter infection 7 expired (58.3%) and 3 were extubated (50%).

B. Pattern of polymicrobial infection and its outcome

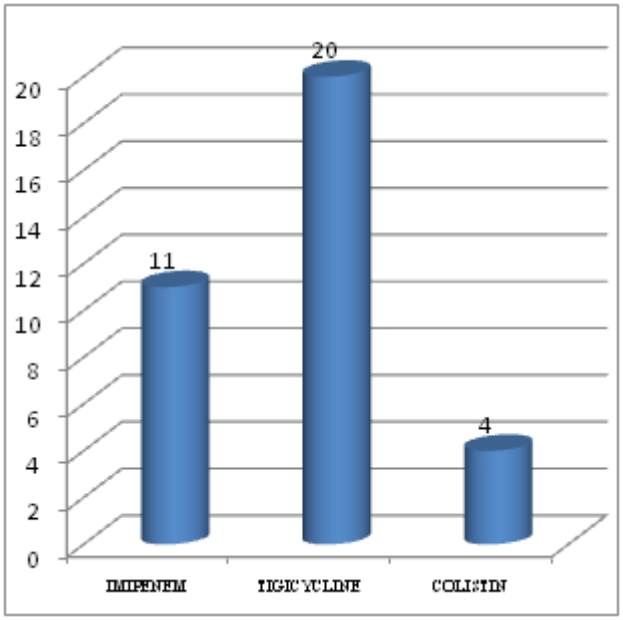
Out of 12 patients who developed polymicrobial VAP ,the most common combination of organisms was K.pneumoniae with Acinetobacter baumannii amounting to 7 isolates(58.3%) followed by combination of Acinetobacter baumanii and Pseudomonas aeruginosa amounting to 2 (16.6%). Out of 11 deaths in polymicrobial VAP, mortality was maximum with K.pneumoniae with Acinetobacter baumannii (63.63%). 15(65.2%) patients expired and 4(57.1%) patients were extubated. Of the patients who developed late VAP 8(34.8%) patients expired and 3(42.9%) patients were extubated

Table 8: Association Between Duration of Stay and Pathogens

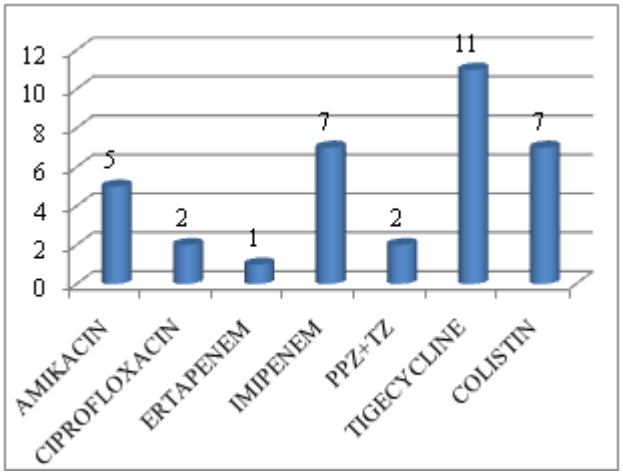
Organism	*N*	*Mean*	*Std. Deviation*	*Std. Error*
ACR	10	8.3000	6.20125	1.96101
KP	3	9.6667	2.51661	1.45297
EC	2	10.0000	7.07107	5.00000
PDM	2	7.0000	2.82843	2.00000
CPS	1	20.0000	.	.
KP+ACR	7	6.4286	.97590	.36886
ACR+EC	1	12.0000	.	.
EC+PDM	1	7.0000	.	.
EC+KP	1	6.0000	.	.
ACR+PDM	2	7.5000	3.53553	2.50000
Total	30	8.3667	4.67188	.85296

From the above table, we interpret that the correlation between the duration of stay and the microbiological pattern is statistically not significant.

Note:
Im-Imipenem,Tig-Tigecycline, Col-Colistin, Am-Amikacin, Azi-Azithromycin, Cefo-Cefoperazone, Ceft-Ceftriaxone, Cip-Ciprofloxacin, Clin-Clindamycin, Do-Doxycycline, Gati-Gatifloxacin, Gent-Gentamycin, Mer-Meropenem,Lin-Linezolid,PPN+TZ-peracillin+Tazobactam,Van-Vancomycin, Cotri-Cotrimoxazole, Azt-Aztreonam, Ticar-Ticarcillin, Ert-Ertapenem

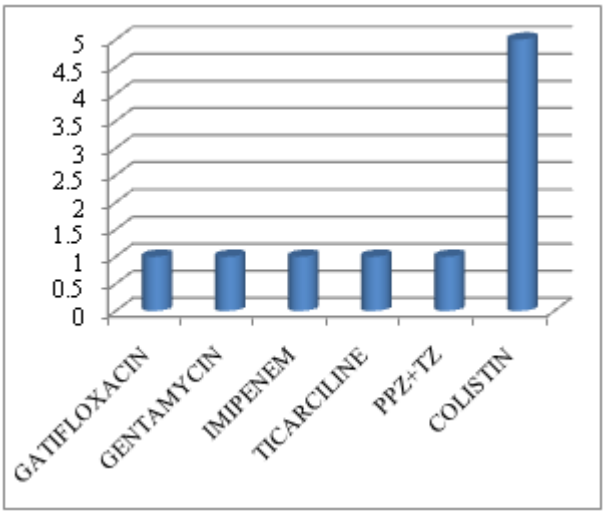


Graph 6: A. Drug Sensitivity Of Acinetobacter Baumannii

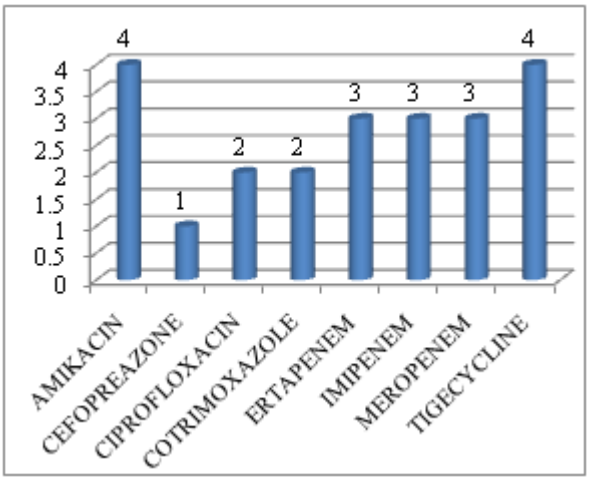


Graph 6: B. Sensitivity Ofklebsiella Pneumoniae

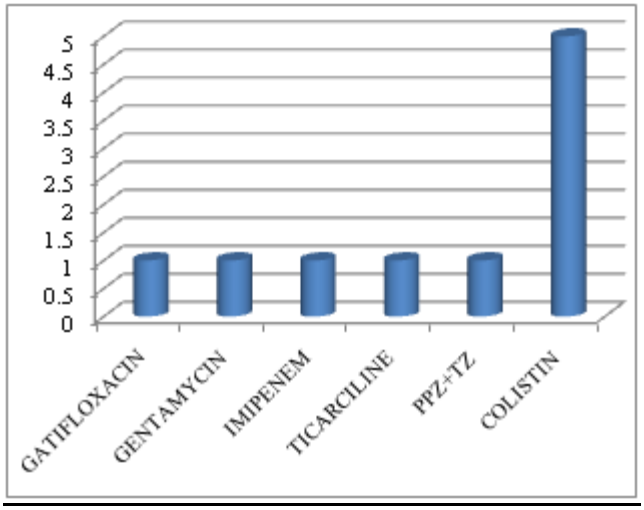
Organism	*No.of.isolates*	*Sensitive*	*Resistant*
A.baumannii	20	Im(11),Tig(20),Col(4)	Am(20), Azi(20), Azt(20), Cefo(20), Ceft(20), Cip(20),Clin(20), Do(20), Gati(20),Gent(20) Im(9),Col(16),Mer(20), Lin(20), PPN+TZ(20),Van(20)
K.pneumoniae	11	Am(5),Cip(2),Ert(1),Im(7), PPN+TZ(2),Tig(11),Col(7)	Am(6),Cip(9), Ert(10),Im(4),PPN+TZ(9), Col(4),Azi(11),Azt(11), Cefo(11) Ceft(11), Clin(11),Do(11) ,Gati(11),Gent(11), Mer(11), Lin(11), Van(11)
P.aeruginosa	5	Gati(1),Gent(1),Im(1), Ticar(1),PPN+TZ(1),Col(5)	Gati(4),Gent(4) Im(4),Ticar(4)PPN+TZ(4), Am(5),Cip(5),Ert(5),Azi(5), Azt(5),Cefo(5) Ceft(5),Clin(5) Do(5),Mer(5),Lin(5),Van(5)
E.coli	5	Am(4),Cefo(1),Cip(2),Cotri(2, Ert(3),Im(3),Mer(3)Tig(4)	Am(1),Cefo(4) ,Cip(3),Cotri(3),Ert(2),Im(2),Mer(2),Tig(1),Gati(5),Gent(5),Ticar(5), Azi(5)Azt(5),Cefo(5) Ceft(5),Clin(5)Do(5),Lin(5) ,Van(5)PPN+TZ(5)
Coagulase Positive Staphylococci	1	Cip(1),Clin(1),Cotri(1),Ery(1), Lin(1),Pris(1)	Am(1),Cefo(1) ,Cip(0),Cotri(0),Ert(1),Im(1),Mer(1),Tig(1),Gati(1),Gent(1), Ticar(1),Azi(1),Azt(1),Cefo(1),Ceft(1),Clin(0),Do(1),Lin(0),Van(1),PPN+TZ(1)



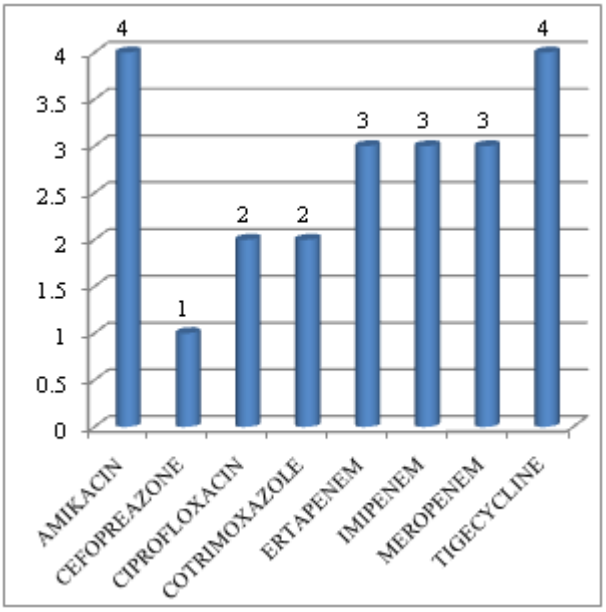
Graph 6: C Sensitivity of Pseudomonas Aeruginosa



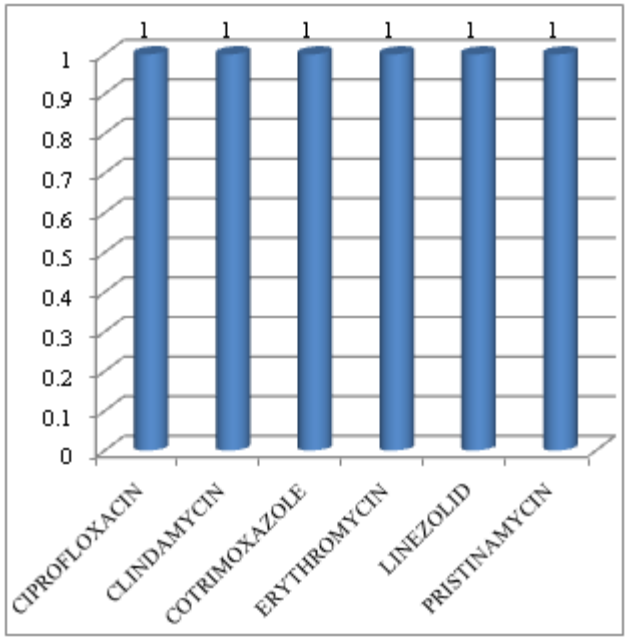
Graph 6: D.Drug Sensitivity Pattern Of Escherichia Coli



Graph 6: E. Sensitivity Of P. Aeruginosa



Graph 6: f. Sensitivity of E. Coli



Graph 9: E. Sensitivity of Coagulase Positive S. Aureus

From the above tables, all the organisms isolated were resistant to all antibiotics that are being routinely used in ICU setting. The acetinobacter isolates were most sensitive to tigecycline and imipenem. The isolates of Klebsiella were sensitive to tigecycline, colistin and imipenem. The isolates of pseudomonas were sensitive to tigecycline and imipenem. The isolates of Escherichia coli were sensitive to amikacin and tigecycline. The coagulase positive staphylococcus was sensitive to ciprofloxacin and clindamycin.

5. Discussion

The incidence of VAP in our study was 34.8%.this correlates with other studies in which the incidence of VAP was 15.5 to 47%, depending on the diagnostic criteria used.[48, 49, 50, and 51] There was no statistically significant association between the age of the patient and development of VAP, indicating that age is neither predisposing nor protective factor for the development of VAP. There was no statistically significant association between the gender of the patient and development of VAP, and both males and females are equally predisposed to VAP.[52]

Table 9: Drug Sensitivity Patterns

	Fagon and colleagues, 1984[50]	*Torres and colleagues,1990*[48]	*Panwar and colleagues,2005*[51]	*Gupta and colleagues, 2010*	*Our study*
Incidence of VAP(%)	27.5	24	47	28.04	34.8
Mortality rate (%)	53	33	37	32.71	76.6
Technique used	Protected specimen brush	Protected specimen brush, BAL	Tracheal aspirate	Tracheal aspirate	Tracheal aspirate
P.aeruginosa	16(31%)	7(28%)	11(46%)	9(30%)	5(16.66%)
S.aureus	17(33%)	5(20%)	6(25%)	8(26.67%)	-
Acinetobacter	8(15%)	6(24%)	2(8%)	6(20%)	20(66.66%)
K.pneumoniae	2(4%)	3(12%)	7(29%)	7(23.33%)	11(36.66%)
Proteus	8(15%)	-	3(13%)	-	-
E.coli	4(8%)	3(12%)	3(13%)	-	5(16.66%)
S. pneumoniae	3(6%)	1(4%)	-	1(3.33%)	-
Coagulase positive staph. Aureus	-	-	-	-	1(3.33%)

The most common organism isolated was Acinetobacter baumannii which was the common pathogen in study by Arindam Dey and Indira Bairy.[54] Out of 20 isolates, 14 were from patients with early onset VAP and 6 from late onset VAP.The next common organism was Klebsiella pneumoniae with total of 11isolates.Out of these 11 isolates, 7 isolates were in early onset VAP, followed by E.coli 5 isolates and pseudomonas with 5 isolates. The least common was of Coagulase positive Staphylococcus aureus with only 1. There is no significant association between the microbiological patterns of VAP in our hospital with duration of stay.

Analysis of antibiotic sensitivity pattern suggests that these organisms were highly resistant to commonly used antibiotics in our hospital. All 20(100%) isolates of Acinetobacter were sensitive to tigecycline, 11(55%) isolates were sensitive to imipenem 4(20%) to colistin. VAP due to multidrug resistant acetinobacter sensitive to tigecycline is common in our setting.[35,38,39,40,46,47] Out of 11 isolates of Klebsiella all 11(100%) were sensitive to tigecycline,7(63.63%) were sensitive to imipenem and 5(45.45%) to amikacin and 2 (18.18%) to ciprofloxacin and piperacillin and tazobactam, suggesting a high prevalence of extended spectrum beta-lactamase(ESBL) producing organisms in our setting.All the 5(100%) isolates of Pseudomonas aeruginosa were sensitive to colistin. 4(80%) out of 5 isolates E.coli was found sensitive to tigecycline and amikacin.3 isolates(60%) were sensitive to carbapenems This observation suggests that the organisms isolated in etiology of VAP in our hospital were resistant to commonly used antibiotics like fluoroquinolones, cephalosporins and aminoglycosides but showed variable sensitivity to tigecycline,colistin and carbapenems. Mortality of VAP group was 76.6% which is very high. A similar high mortality was found in other studies.[53]

6. Conclusions and Summary

Thus , we conclude that most of the VAP cases in our setting were early onset VAP & majority of these are caused by highly resistant strains.VAP due to multidrug resistant acetinobacter sensitive to tigecycline is common in our setting. And local epidemiological data should be connected at all centres, as the information can help in guiding the initial empirical antibiotic therapy, which would be more rationale and help in decreasing mortality and morbidity. An effective empirical antibiotic therapy would also help in preventing development of more resistant strains. CLINICAL UTILITY: To choose the most appropriate empirical antibiotics

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