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Clinical Profile of Ventilator Associated Pneumonia in a Tertiary Care Hospital

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ABSTRACT
Ventilator-associated pneumonia (VAP) continues to be a major threat to patients admitted in intensive care units (ICU) and receiving mechanical ventilation (MV).VAP occurs in 9–27% of all intubated patients. VAP may be caused by a wide spectrum of bacterial pathogens, which may be polymicrobial and rarely due to viral or fungal pathogens in immunocompetent hosts.This study aims to describe clinical and microbiological profile of ventilator associated pneumonia and outcome of treatment at Medicine ICU, in a tertiary care hospital Solapur Maharashtra. This is a hospital–based prospective observational study. All patients suffering VAP who don ‘t have any prior pneumonia. The diagnosis of VAP was made using the clinical and radiological criteria.

I. INTRODUCTION

Ventilator associated pneumonia (VAP) is defined as pneumonia occurring more than 48 hours after endotracheal intubation/initiation of mechanical ventilation or pneumonia developing even after extubation. Ventilator-associated pneumonia (VAP) continues to be a major threat to patients admitted in intensive care units (ICU) and receiving mechanical ventilation (MV).

VAP developed during the first 4 days of mechanical ventilation is early onset, usually less severe mostly caused by antibiotic sensitive bacteria’s and with better prognosis. Whereas late onset VAP develops 5 or more days after the initiation of mechanical ventilation, and is due to multidrug resistant (MDR) pathogens and is usually associated with increased morbidity and mortality.

VAP occurs in 9–27% of all intubated patients. VAP may be caused by a wide spectrum of bacterial pathogens, which may be polymicrobial and rarely due to viral or fungal pathogens in immunocompetent hosts.

Common pathogens causing VAP includes Pseudomonas Spp. Escherichia coli, Klebsiella pneumonia and Staphylococcus aureus with varying prevalence.Due to the increased incidence of MDR organisms in intensive care units(ICU), early and correct diagnosis of VAP is mandatory for optimal antibiotic therapy.

Pseudomonas spp., Acinetobacter spp., and even Enterobacteriaceae are quite often multidrug resistant due to production of extended spectrum beta-lactamase (ESBL). The frequency of specific MDR pathogens causing VAP varies in hospitals, patient population, prior use of antibiotics, patient characteristics, certain clinical circumstances, (such as ARDS, traumatic injuries, or burns etc) and geographic locations emphasizing the importance of local epidemiological and microbiological data.

The average time taken to develop VAP from the initiation of mechanical ventilation is around 5-7 days, with mortality rate quoted as between 24% and 76%.

II. MATERIAL & METHODS

Source of data: The patients admitted in medicine ICU at tertiary care hospital, who were on mechanical ventilator for more than 48 hour, during the period from may 2020 to may 2021.
Study design: All the patients on mechanical ventilator for more than 48 hours in critical care unit, who fulfilling inclusion criteria were considered for case identification and study was prospective study.
Sample size: 50 patients
Duration: may 2020 to may 2021.
Inclusion criteria: All patients subjected to mechanical ventilation for more than 48 hours in MICU, Age > 14 years of either sex.
Exclusion criteria: All patients with clinical and radiological signs suggestive of pneumonia on admission , Patients having pneumonia prior to mechanical ventilation , Age < 14 years of either sex.

Method of study:

A hospital–based prospective observational study will be carried out. Informed consent was taken and patient was assessed clinically. Detailed history and physical

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examination was carried out in each patient, after taking permission from institutional review board and scientific committee. Investigations conducted in clinically suspected to have VAP were. Routine – Complete blood picture, CRP, ESR, urine routine, RBS, serum creatinine and blood urea, serum electrolytes. Specific – Chest x ray, endotracheal aspirate culture and sensitivity, ET aspirate for gram stain, blood culture and sensitivity and arterial blood gas analysis. All data were entered into standard proforma and analyzed. Patients were evaluated clinically, radiologically and bacteriologically to determine the presence of pneumonia, isolate the causative microorganism and sensitivity to antibiotics and presence of comorbid conditions like DM, COPD, CKD, IHD etc. After evaluating for mentioned factors, the data collected and studied in relation to age, sex, duration of ventilation, causative microorganism and antibiotic sensitivity, comorbid illness, risk factors and outcome.

III. OBSERVATIONS & RESULTS

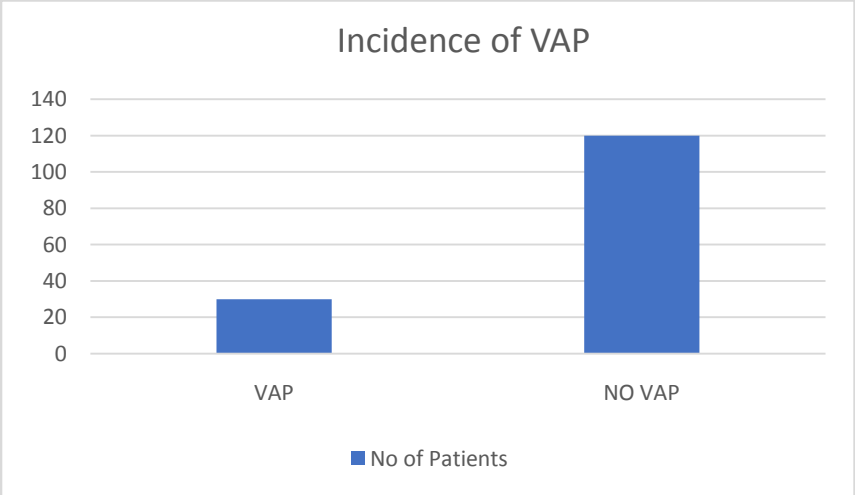
Total 700 patients were admitted to medicine ICU of tertiary care hospital. under medicine department during one year study period. Out of 700,total 150 patients were put on mechanical ventilation in that 50 patients were clinically suspected as VAP. Out of 50, 30 patients were diagnosed to have VAP based on CPIS.

Incidence is 20%. Our study included 29 (58%) males and 21(42%) females, out of which 22 (73.3%) males and 8(26.6%) females had VAP.

Table 1:Incidence of VAP

	NUMBER OF PATIENTS	PERCENTAGE
VAP	30	20%
NO VAP	120	80%
TOTAL	150	100%

Graph 1: Incidence of VAP



Incidence of VAP in our study is 20 %.

S.NO	AGE GROUP(YEARS)	NUMBER	PERCENTAGE
1.	15-25	2	6.6%
2.	25-35	6	20%
3.	35-45	10	33.3%
4.	45-55	7	23.3%
5.	55-65	5	16.6%
	TOTAL	30	100%

Table 2:The age distribution of VAP

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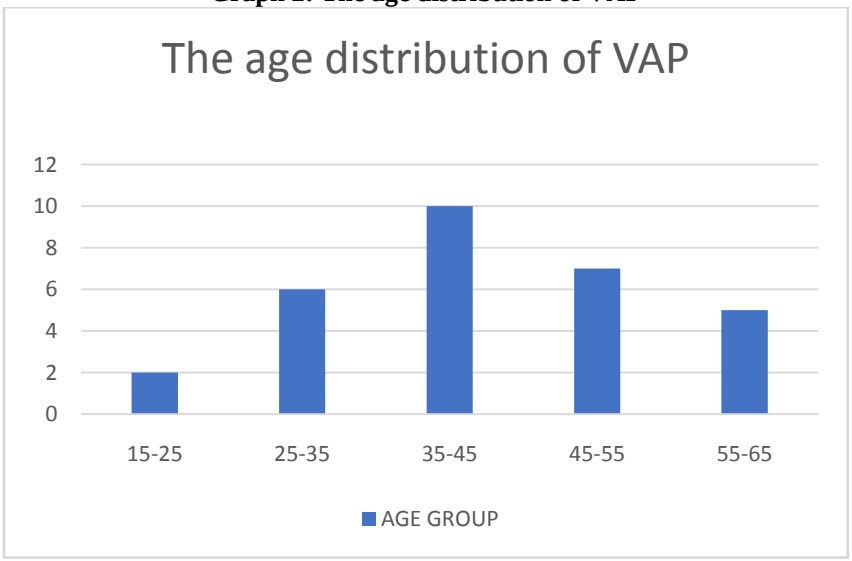
Graph 2: The age distribution of VAP

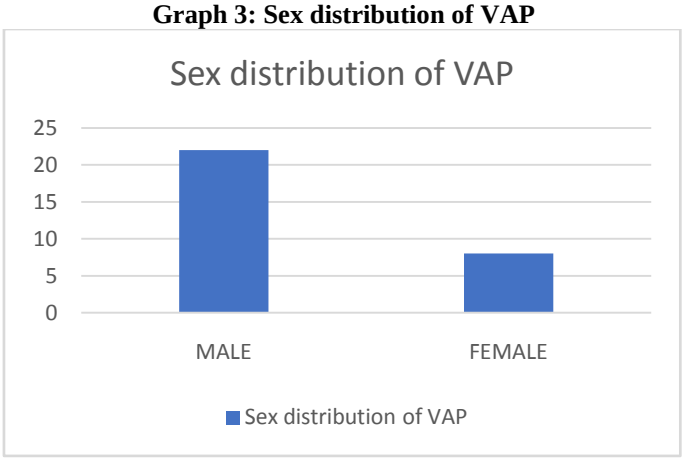


In ourstudy, it was found that, the more VAP patients are seen in age group of 35-45 years.

Table 3: Sex distribution of VAP

	NUMBER	PERCENTAGE
MALE	22	73.33%
FEMALE	8	26.66%
TOTAL	30	100%

Graph 3: Sex distribution of VAP



In our study males are more affected than females.

Table 4: VAP and Onset

VAP is divided into early onset and late onset VAP and their distribution as follows.

VAP TYPE	NUMBER	PERCENTAGE
Early onset	12	40%
Late onset	18	60%
Total	30	100%

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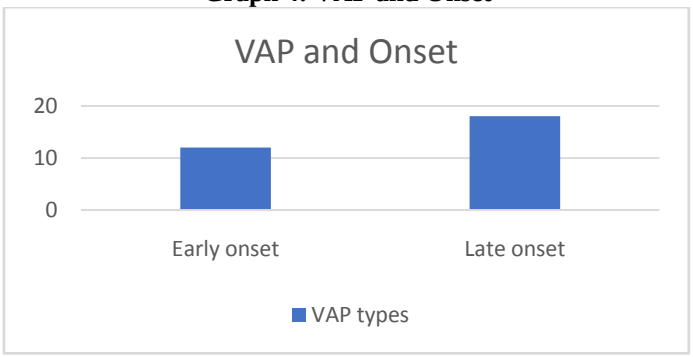
Graph 4: VAP and Onset

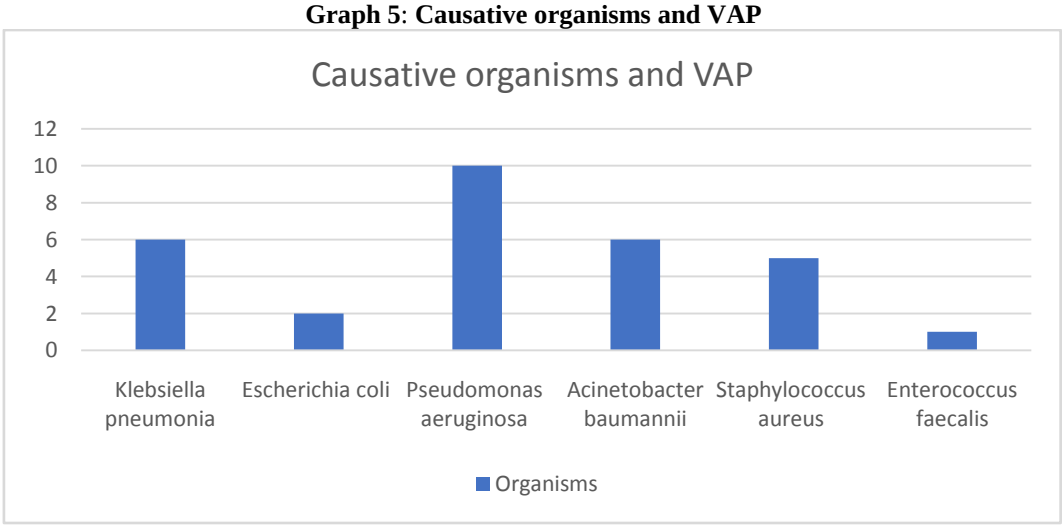


In our study majority of patients were found to have late onset VAP.

Table 5: Causative organisms and VAP

ORGANISM	NUMBER	PERCENTAGE
Klebsiella pneumonia	6	20 %
Escherichia coli	2	6.6 %
Pseudomonas aeruginosa	10	33.3 %
Acinetobacterbaumannii	6	20 %
Staphylococcus aureus	5	16.6 %
Enterococcus faecalis	1	3.3 %
TOTAL	30	100 %

Graph 5: Causative organisms and VAP



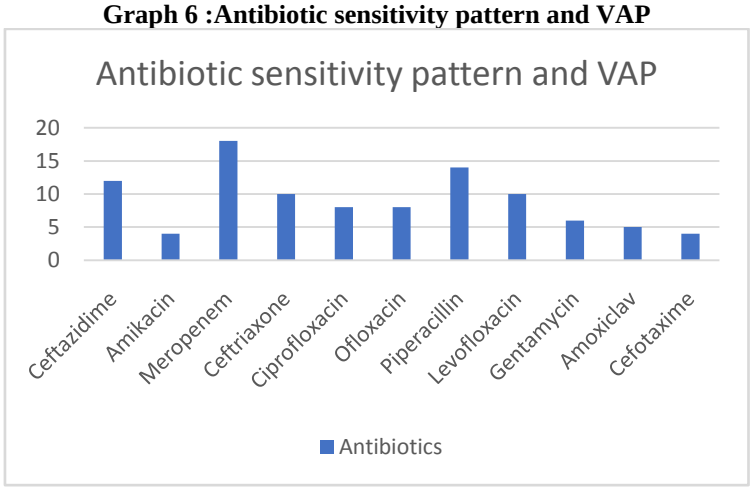
In our study pseudomonas aeruginosa was the most common organism isolated inVAP.

Table 6: Antibiotic sensitivity pattern and VAP

ANTIBIOTICS	NUMBER	PERCENTAGE (%)
Ceftazidime	12	40
Amikacin	4	13.3
Meropenem	18	60
Ceftriaxone	10	33.3

Ciprofloxacin	8	26.6
Ofloxacin	8	26.6
Piperacillin	14	46.6
Levofloxacin	10	33.3
Gentamycin	6	20
Amoxiclav	5	16.6
Cefotaxime	4	13.3

Graph 6 :Antibiotic sensitivity pattern and VAP



Commonest antibiotic for which most bacteria were sensitive in VAP was meropenem(60%), followed by piperacillin(46.6%), ceftazidime(40%),levofloxacin(33.3%) etc.

Table 7: X-RAY FINDING IN VAP

LOBAR DISTRIBUTION	**NUMBER**	**PERCENTAGE (%)**
Right side	18	60
Left side	7	23.3
Bilateral	5	16.6
TOTAL	30	100

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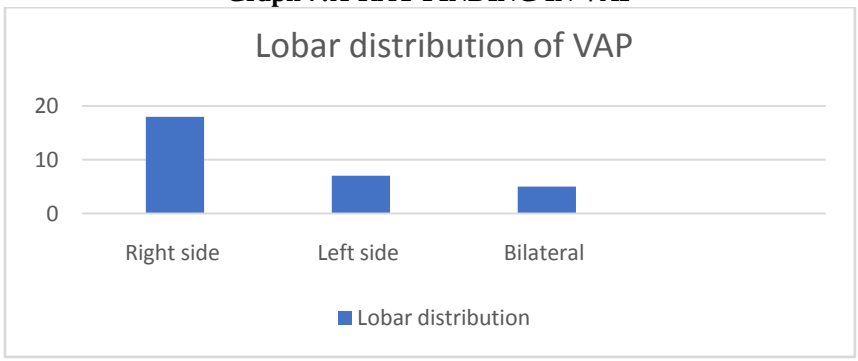
Graph 7:X-RAY FINDING IN VAP

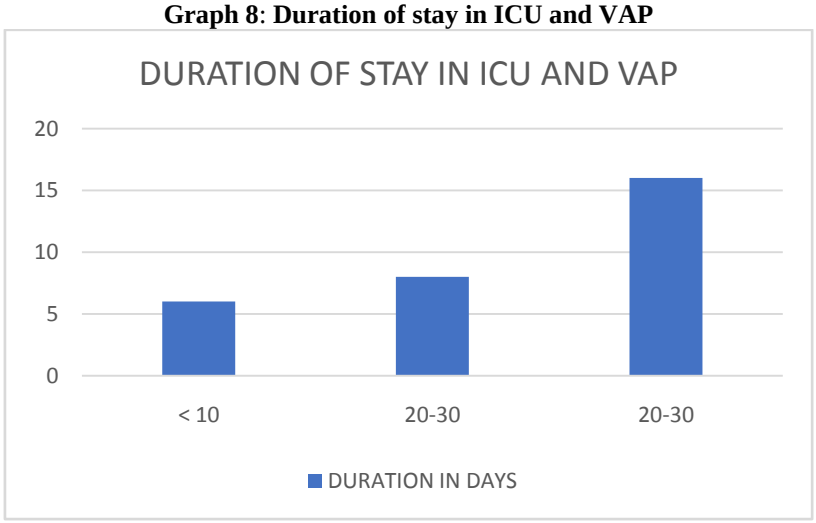


In majority of cases, the CXR infiltrateswere in the Right lung.

Table 8 : Duration of stay in ICU and VAP

DURATION IN DAYS	NUMBER	PERCENTAGE(%)
< 10	6	20
10-20	8	26.6
20-30	16	53.3
TOTAL	30	100

Graph 8: Duration of stay in ICU and VAP



The above graph shows as duration of stay in ICU increased incidence of VAP increases.

Table 9: Risk factors and VAP

RISK FACTORS	NUMBER	PERCENTAGE (%)
Chronic lung disease	5	16.6
Aspiration	17	56.6
Reintubation	8	26.6

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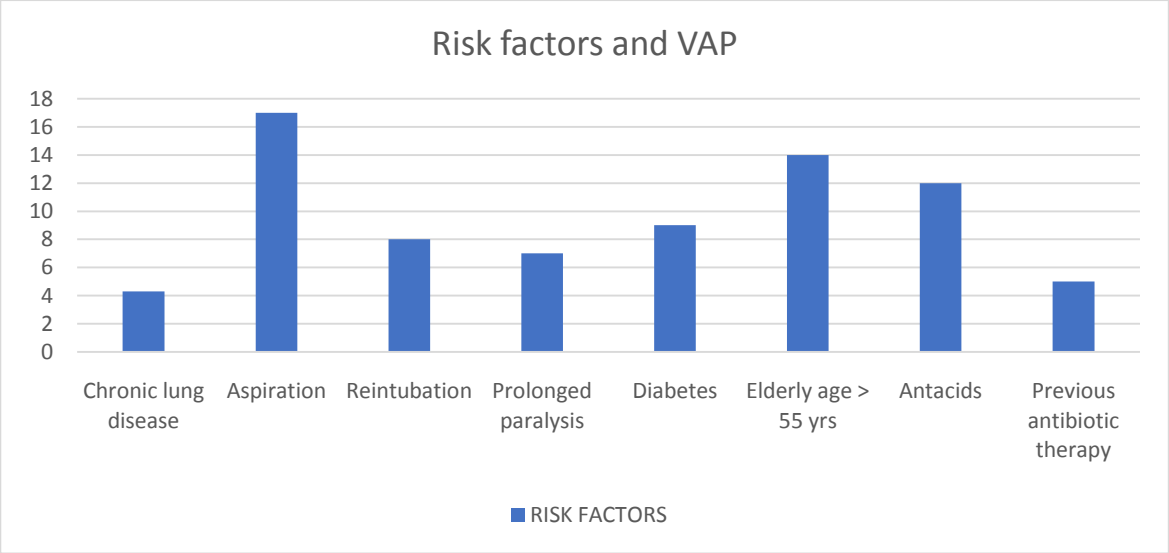
Prolonged paralysis	7	23.3
Diabetes	9	30
Elderly age > 55 yrs	14	46.6
Antacids	12	40
Previous antibiotic therapy	5	16.6

Graph 9:Risk factors and VAP



The commonest risk factor predisposing to VAP was aspiration (56.6%), elderly age (46.6%),use of antacids (40 %) etc.

Table 10: Clinical features and VAP

Clinical features	**NUMBER**	**PERCENTAGE**
Fever	24	80
Tachypnoea	18	60
Fall in SPO_2	16	53.3
Crepitation	15	50
Leucocytosis	18	60
Chest X ray (consolidation)	30	100

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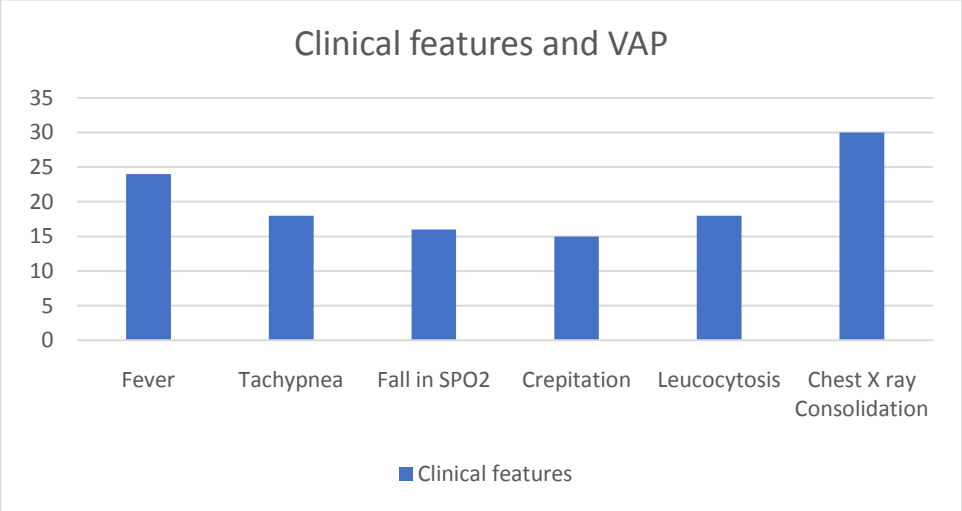
Graph 10 :Clinical features and VAP

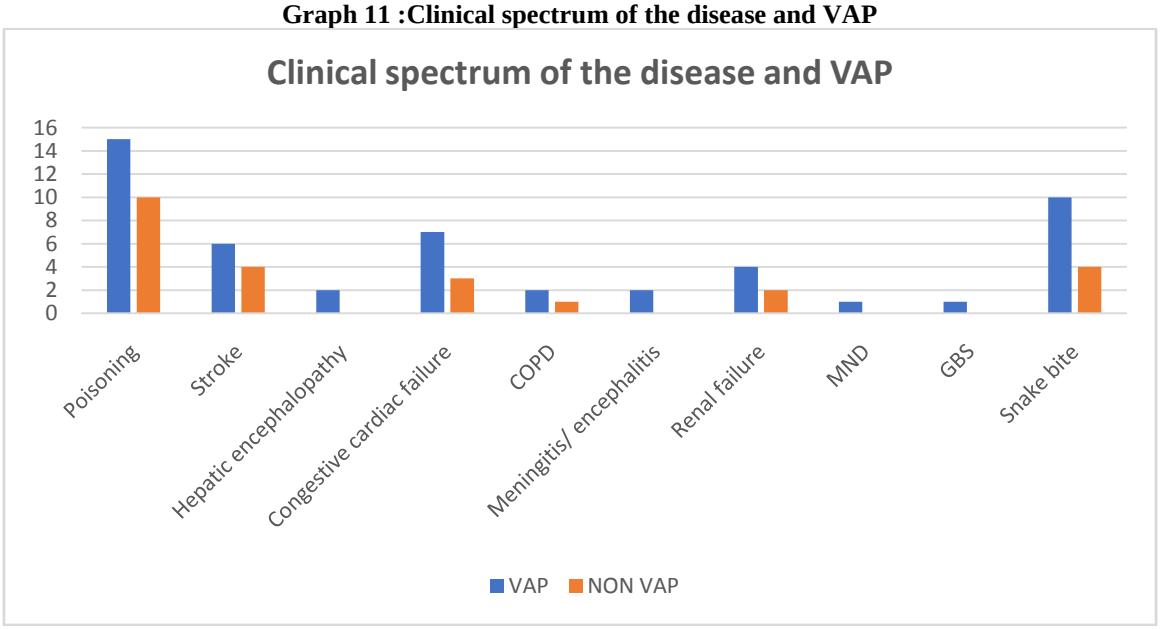


Most common clinical features were consolidation, fever and tachypnoea.

Table 11: Clinical spectrum of the disease and VAP

Diseases	Total no of patients	VAP	NON VAP
Poisoning	15	10	5
Stroke	6	4	2
Hepaticencephalopathy	2	2	-
Congestive cardiac failure	7	3	4
COPD	2	1	1
Meningitis/ encephalitis	2	2	-
Renal failure	4	2	2
MND	1	1	-
GBS	1	1	-
Snake bite	10	4	6
Total	50	30	20

Graph 11 :Clinical spectrum of the disease and VAP



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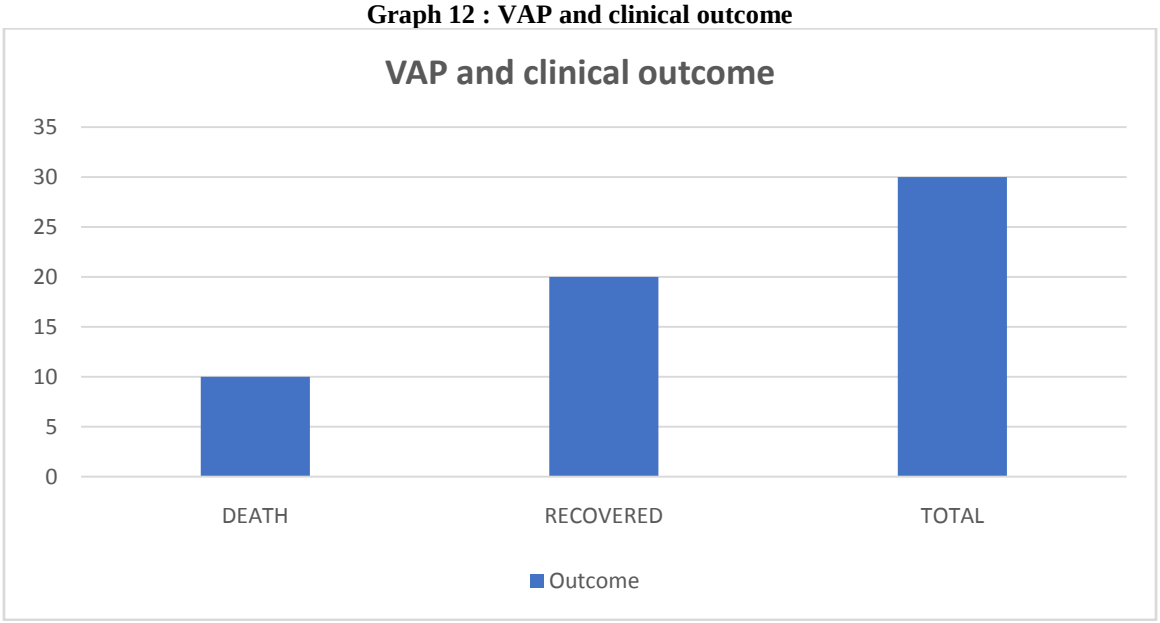
The clinical spectrum of our patients that includes 15 cases of poisoning, 6 cases of stroke, 2 cases of hepatic encephalopathy, 7 cases of congestive cardiac failure, 2 cases of COPD and meningitis each, 4 cases of renal failure, MND and GBS each and 10 cases of snake bite.

Table 12: VAP and clinical outcome

OUTCOME	NUMBER	PERCENTAGE (%)
DEATH	10	33.3
RECOVERED	20	66.6
TOTAL	30	100

Graph 12 : VAP and clinical outcome



Overall 20 patients (66.6%) of VAP were recovered and discharged. 10 patients (33.3%) of VAP were expired.

Table 13: AGE DISTRIBUTION AND OUTCOME

AGE GROUP (YRS)	DEATH	RECOVERED	TOTAL
15-25	**0**	2	2
25-35	1	5	6
35-45	4	6	10
45-55	2	5	7
55-65	3	2	5
TOTAL	10	20	30

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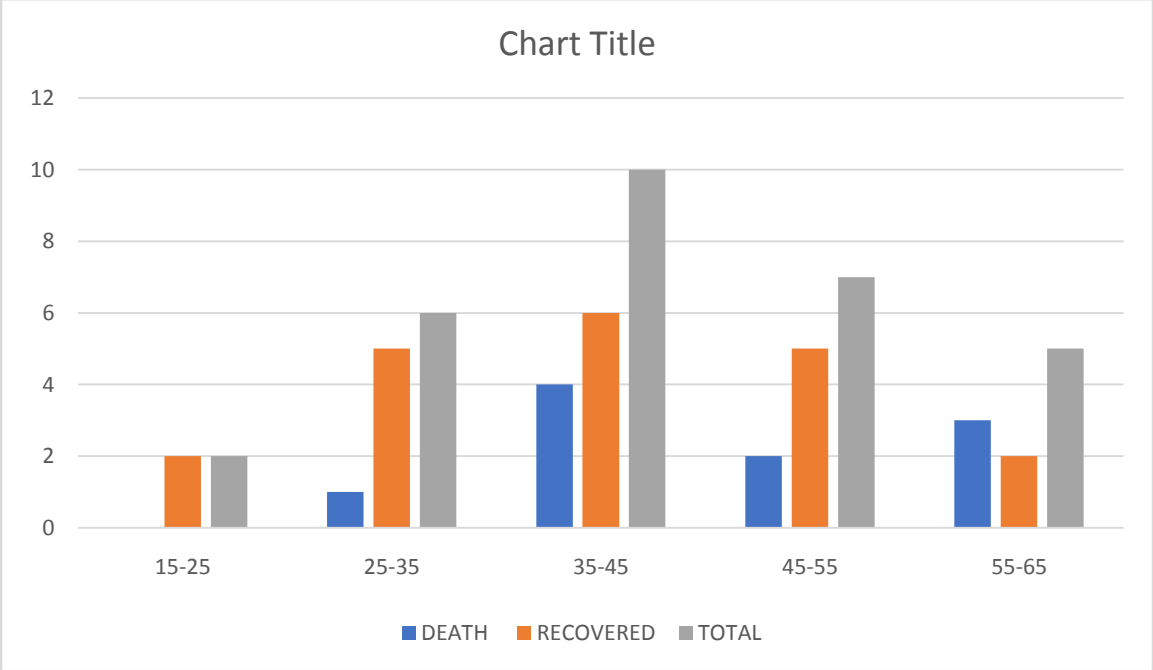
Graph 13: AGE DISTRIBUTION AND OUTCOME



The mortality rate was high in patients of age group 35-45 years which accounts for 40% of total deaths.

IV. OBSERVATIONS AND DISCUSSION

VAP is the most common nosocomial infection among the patients receiving mechanical ventilation. Present study was conducted to determine the incidence of VAP, clinical pattern and organisms causing it, antibiotics sensitivity of organism causing VAP, risk factors for VAP and outcome of VAP in our hospital.

A total of 150 patients admitted to the medicine ICUof tertiary care hospital during study period were kept on mechanical ventilation. Out of 150 patients 50 patients were on mechanical ventilation for more than 48 hours and clinically suspected as VAP.

Out of 50 patients, 30 patientswere diagnosed to have VAP based on CPIS.

Incidence:

The incidence of VAP in our study was 20 % which is almost in accordance with other studies conducted by Trivedi et al, and Fagon et al[1] (15 to 27 %).

Age:

In the present study, it was found that the maximum number of VAP patients was seen in age group of 35-45 years., which is similar in other Indian studiesRakshit[3], Joseph and Dey[86]and western studies Alp and Rodrigues[13].

Sex:

Our study included 29 (58%) males and 21(42%) females, out of which 22 (73.3%) males and 8(26.6%) females had VAP.There was male sex predilection to VAP in our study and was the same in other studies done by Rodrigues et al[13].

VAP and onset:

In the present study 12 (40%) patients had early onset VAP ,18 (60%)patients had late onset, which is similar to other studies. The mean duration of ventilation in our study for VAP onset is 11 days which almost matches with other studies conducted by Heyland DK, et al and Cook DJ et al[87].

This shows that VAP increases with the duration of mechanical ventilation. The risk of acquiring pneumonia appears to be increases with the duration of mechanical ventilation in a study done by Fagon et al[(1)] and was found to be 7% at 10 days and 19% at 20 days.

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VAP	PRESENT STUDY	Dey et al[86]	Abdel et al[43]
EARLY ONSET	40%	47.7 %	42 %
LATE ONSET	60%	52 %	44 %

The mean duration of ventilation can effectively be reduced by administrating a proper weaning protocol.

Clinical spectrum of the disease and VAP:

The clinical spectrum of disease in this study was compared to other study by Panwar et al and Mohanty and Sidharth et al

Diseases	**Present study**	**Panwar et al[3]**	**Mohanty et al, Sidharth et al[88]**
Poisoning	15	6	4
Stroke	6	5	4
Meningitis / Encephalitis	2	3	3
GBS	1	4	3
Snake bite	10	1	2

The prevalence of VAP was greater in patients with diseases necessitating prolonged mechanical ventilation.A more number of VAP cases in poisoning and stroke reflect, the more number of admission during the study period and also it shows poisoning and stroke cases needs prolonged ventilatory support and subsequent VAP.

Risk factors and VAP:

In our study most common risk factor for development of VAP was aspiration (56.6%) , elderly age(46.6%),use of antacids (40 %) etc.

Overall aspiration, use of antacids and underlying comorbid illness are most common risk factors for VAP. Similar findings were reported by Beck -Sague CM, Kaler W, Rello J, et al[27].Kalil AC, Metersky ML, Klompas M, et al[12].

Clinical features and VAP:

In our studymost common clinical features of VAP wereconsolidation (100%),fever (80%),tachypnoea(60%) , leucocytosis (60%),fall in SPO2 (53.3),crepitations (50%).

Overall consolidation and fever were the most common clinical features in VAP, which go in accordance with study by Chastre J, Fagan JY etal[1] .

Causative organisms and VAP:

In our study the most frequently isolated organism in VAP were Pseudomonas aeruginosa (33.3 %), Klebsiella (20 %), Acinetobacter (20%), staphylococcus aureus (16%), Escherichia coli (6.6%) and enterococcus faecalis (3.3%).

Organism	**Present study**	**Rajendran R, Girish Netal[(45)]**	**Rakshit etal[(3)]**
Klebsiella	6 (20 %)	20 (23.8 %)	7 (29.4 %)
Escherichia coli	2 (6.6%)	18 (21.4 %)	3 (12.6 %)
Pseudomonas	10 (33.3 %)	12 (14.2 %)	11 (46 %)
Acinetobacter	6 (20 %)	11 (13.9 %)	2 (8.2 %)

The organisms causing VAP were different in different study groups mainly because of geographical variation. The present study helped to know the commonest organisms causing VAP at our hospital.

Antibiotic sensitivity pattern and VAP:

In our study the commonest antibiotic for which most bacteria were sensitive in VAP was meropenem (60 %), followed by piperacillin (46.6 %), ceftazidime(40 %), levofloxacin (33.3%) etc.

Overall meropenem and piperacillin are the most sensitive antibiotics in VAP. This is mainly attributed due to most common organism causing VAP were gram negative organisms.

Antibiotics	Sensitivities	Sensitivities
	Present study	Harsha, Virendra et al[46].
Meropenem	18 (60 %)	16 (66.6 %)
Gentamycin	6 (20 %)	16 (66.6 %)
Amikacin	4 (13.3%)	20 (83.3 %)
Piperacillin	14 (46.6 %)	19 (79.2 %)
Levofloxacin	10 (33.3%)	13 (54.2 %)
Cefotaxime	4 (13.3%)	5 (20.8 %)
Ciprofloxacin	8 (26.6%)	16 (66.6%)

As most of bacteria isolated were resistant to various antibiotics,which results in the development of MDR pathogens. This is mainly because of prolonged stay in hospital, use of corticosteroids and prior use of antibiotics, inappropriate empirical antibiotic therapy and underlying morbidity. Ranjan et al. observed that prior use of antibiotics increases the risk of acquiring drug resistant pathogens. Similarly, Joseph et al. stated that prior antibiotic therapy was independent risk factor for VAP by MDR pathogens.

The organisms isolated in the present study were predominantly gram negative. The antibiotics such as meropenem, piperacillin , ceftazidime have been found to be good antibiotic options for VAP to start with till culture reports are available.

X-RAY FINDING IN VAP:

In our study 60 % of patients had infiltrates in right lung.23.3 % of patients in the left lung 16.6 % bilaterally . The higher percentage of infiltrates in the right lung lower lobe is because of aspiration being the most common precipitating factor for VAP.[89] Autopsy studies by Marquette, C. H., M. C. Copin, F. Wallet, R. Neviere, F. Saulnier, D. Mathieu, A. Durocher, P. Ramon, and A. B. Tonnel. 1995 have indicated that VAP frequently involves posterior right lower lobe.

DURATION OF STAY IN ICU AND VAP:

Our study shows as duration of stay in ICU increased incidence of VAP increases.In a 2017 retrospective study, it was reported that ventilation time and ICU length of stay were significantly longer in patients with VAP than in those without VAP (Abdelrazik and Salah Abdelazim, 2017). Mechanical ventilation for more than 2 weeks was a risk factor for VAP in ICU patients (Blot et al., 2014; Ding et al., 2017; Liu et al., 2017).[90]

VAP and clinical outcome:

The overall mortality in our study was 33.3 %. In other studies mortality varied from 30% to 50%. The mortality in VAP patient was significantly higher than non VAP patient. Gupta et al and Panwar et al found the same type result.

Higher rate of mortality in VAP in our study is because of longer duration of mechanical ventilation and underlying co-morbid conditions.

Authors	Study year	Mortality rate of VAP (%)
Kerver et al[91]	1986-87	30
Torres et al[92]	1987-88	33
Fagon et al[93]	1989-94	53
Rakshit et al[3]	2003-04	37
Present study	2018-19	33.3

The reason for high prevalence of VAP in our study was may be due to small number of cases, the presence of co morbid illness and most of the patients were seriously ill. The health seeking behaviour in our patients is different when compared to that of the western population. By the time the patient is referred to the tertiary care centre his/her underlying disease would have progressed and may be irreversible. This may necessitate longer duration of mechanical ventilation which is directly proportional to the development of VAP, so the higher mortality.

V. CONCLUSION:

- VAP is a serious problem in ICU leading to prolonged hospitalisation, its associated high mortality rate.
- Incidence of VAP in our study is 20%.
- The causative pathogens of VAP may vary depending on hospital.
- Most common organisms isolated in VAP in present study were Pseudomonas, klebsiella and acinetobacter.
- Most common underlying risk factors are, aspiration and underlying comorbid illness, elderly age,use of antacids.
- Knowledge of the susceptibility pattern of the local pathogens causing VAP can guide the clinician to choose the appropriate empirical antibiotics.
- Most of the isolated organisms in our study are susceptible to meropenem, piperacillin, ceftazidime.
- The increase prevalence of VAP in our study is mainly because of underlying comorbid illness and prolong ICU stay.
- Late-onset VAP is associated with poor prognosis as compared to the early-onset variety.
- The MDR pathogens are increasing in our ICU.
- The emergence of MDR pathogens can be prevented by adopting an antibiotic policy and dose de-escalation regimens.
- Preventive strategies should be followed in critical care units to decrease the prevalence of VAP.

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