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A Study of Ventilator Associated Pneumonia (VAP) in Intensive Care Unit (ICU) setting

KEYWORDS: VENTILATOR ASSOCIATED PNEUMONIA, INTENSIVE CARE UNIT, MICRO ORGANISM

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ABSTRACT

Background: *Ventilator-associated pneumonia (VAP) is a major cause of hospital morbidity and mortality despite recent advances in diagnosis and accuracy of management. However, as taught in medical science, prevention is better than cure is probably more appropriate as concerned to VAP because of the fact that it is a well preventable disease and a proper approach decreases the hospital stay, cost, morbidity and mortality.* ***Aims:*** *The aim of the study was to study the prevalence of ventilator associated pneumonias in intensive care unit, to identify the type of micro-organisms & to study the antibiotics sensitivity of these micro-organisms.* ***Methodology:*** *The present study comprised of 60 patients admitted in surgical intensive care unit as well as medical intensive care unit who were on ventilator for different reasons. The patients were treated appropriately according to antibiotic sensitivity. CPIS- (clinical pulmonary infection score) was recorded.* ***Results:*** *the incidence of VAP was more common in men (68.3%) than female (31.7%). The occurrence of VAP was more common in the age group of 36-45 years (26.7%). 25 % patients were catagorised under early onset VAP and 75% under late onset VAP. Mode of airway in 93.3% patients was endotracheal route whereas only 6.7% patients were tracheostomised. 28.33 % patients developed VAP who were diagnosed as stroke with hypertension. Acinetobacter Spp and Klebsiella were the commonest isolates obtained in both early and late onset VAP. Piperacillin and Tazobactum was sensitive in 46.7% cases and Ciprofloxacin was the most resistant (40%) antibiotic.* ***Conclusion:*** *In conclusion the present study showed a gradual increase in VAP along with the duration of stay in ICU. Most of the affected patients were in 4th decade with male predominance. Acinetobacter Spp (45%) was the most prominent pathogen that was responsible for VAP. Piperacillin with Tazobactum was sensitive among 46.7% of the cases where as Ciprofloxacin was the most resistant antibiotic*

Introduction

Ventilator associated pneumonia refers to development of parenchymal lung infection in a patient who has undergone intubation and received mechanical ventilation for > 48 hours.[1] It is characterized by presence of new or progressive infiltrate, signs of systemic infection (fever, altered white blood cell count), change in sputum characteristics and detection of causative agents.[2]

VAP is estimated to occur in 9-27 % of all mechanically ventilated patients, with the highest risk being early in the course of hospitalization.[3] It is the second most common nosocomial infection in the intensive care unit (ICU) and the most common in mechanically ventilated patients.[4] VAP rates range from 1.2 to 8.5 per 1,000 ventilator days and are reliant on the definition used for diagnosis. According to Indian statistical analysis, ventilator associated pneumonia was 24 out of 51 cases. The mortality in the Ventilator Associated Pneumonia group was 37%.[5] According to Bangalore Statistical analysis incidence of ventilator associated pneumonia was 8.3% of the total number of patients on ventilator support.[6]

The principal risk factor for development of ventilator associated pneumonia is presence of endotracheal tube.[7] The tubes interfere with normal protective upper airway reflexes, prevent effective coughing and cause gross or micro aspiration of orophryngeal organisms into distal bronchi, either directly or secondary by reflux from stomach into the oropharynx. Other routes like haematogenous carriage of microorganisms to lung from remote sites of catheter related blood stream infections, from environment, contaminated respiratory equipments, bronchoscopes, medical aerosols, water or air are less common.[8]

Early onset VAP, defined as occurring within the first 4 days of elective ventilation, usually carries a better prognosis and are more likely caused by antibiotic sensitive bacteria,Late onset VAP (5 days or more) are usually caused by MDR pathogens and associated with increased patient mortality and morbidity.[1]

Culprits of early VAP include streptococcus pneumoniae, haemophilus influenzae, methcillin sensitive staphylococcus aureus, escherichia coli, klebsiella pneumoniae and proteus species.

Late onset VAP bacteria are typically MDR such as methcillin resistant staphylococcus aureus (MRSA), acinetobacter baumanni, pseudomonas aeruginosa.[1] But the etiologic agents widely differ according to population in ICU, duration of hospital stay and prior antimicrobial therapy.[9]

Critical illness is associated with immunosupression and this increases susceptibility to nosocomial infection.[10]

Detection of causative agents is crucial for VAP which is done by collecting lower respiratory tract sample by non invasive (ETA) techniques and culturing quantitatively and semi quantitatively as treatment with antimicrobials improves outcome.

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The present study was undertaken with the aim to study the prevalence of ventilator associated pneumonias in intensive care unit, to identify the type of micro-organisms & to study the antibiotics sensitivity of these micro-organisms.

Methodology:

After obtaining ethical clearance from our Institute's Ethical Committee and informed written patient consent, total 60 patients (>18 years) of both sexes admitted in surgical intensive care unit as well as medical intensive care unit who were on ventilator for > 48 hours for different reasons were enrolled in this study. Patients with clinical and radiological signs of pneumonia, ARDS and who were admitted with any respiratory tract infections were excluded from the study.

Age, sex, date of admission to ICU, date of initiating mechanical ventilation and mode of access to patients airway i.e. orotracheal or tracheostomy was recorded. Indications of mechanical ventilation were noted. In each patient, ventilator mode and settings was recorded and any change in settings was recorded daily. Patient's vitals, general and physical examination and oxygen saturation and position of the patients was monitored regularly.

During the initial stage of ventilation, patients were adequately sedated. All necessary measures was taken for prevention of hospital acquired infections. A battery of routine investigations were performed and special investigations like culture of tracheal secretion were done. Endotracheal aspirate >1 ml was collected under aseptic procedures after 48 hours till patient was extubated. It was collected using 22 inch Ramsons 12F suction catheter with a mucus extractor gently introduced via endotracheal tube 25-26 cm. Endotracheal aspirate (ETA) sample was collected for each patient and sent for microbiological processing. The findings were tabulated as

1. Type of causative micro organism
2. Antibiotic sensitivity.

The patients were treated appropriately according to antibiotic sensitivity. CPIS-clinical pulmonary infection score was recorded as attached proforma.

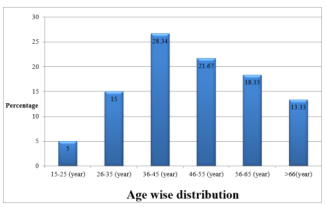
Statistical Analysis

All the data was collected and verified. Collected data was subjected to SPSS (v2.0) statistical analysis. Data was represented as frequencies & mean with standard deviation.

Results:

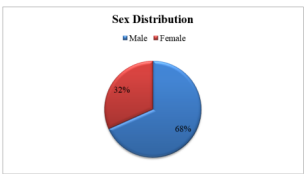
Age wise distribution of the patients was shown in Fig 1. Most of the patients who were affected by VAP were from 36-45 age group. 15-25 age group patients were least affected.

Figure 1: Age wise distribution of studied patients.



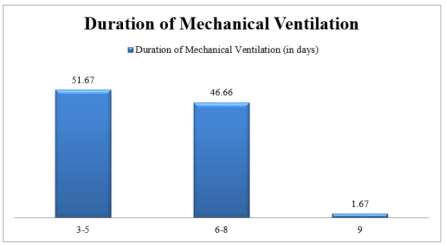
Gender wise distribution of patients was mentioned in Fig 2. Out of 60 patients 41(68.33%) were male and remaining 19(31.67%) were female.

Figure 2: Sex distribution of studied patients.



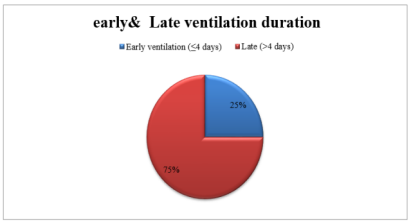
Distribution of cases according to the duration of mechanical ventilation was mentioned in the Fig 3. 31 (51.67%) patients were mechanically ventilated for the duration of 3-5 days whereas 28 (46.66%) patients were mechanically ventilated for 6-8 days. Only one patient was on ventilator for 9 days.

Fig 3: Distribution of cases according to duration of mechanical ventilation



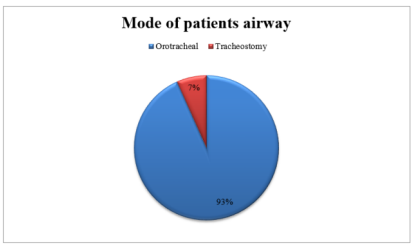
Distribution of cases according to early or late onset of mechanical ventilation was shown in Fig 4. Only 15(25.0%) patients were mechanically ventilated for ≤4 days and remaining 45 (75.0%) patients were on ventilator for > 4 days.

Fig 4: Distribution of cases according to early and late onset of ventilation



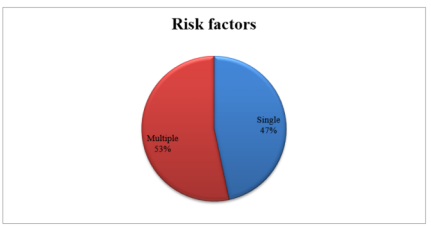
Mode of airway of studied patients was mentioned in Fig 5. 56 (93.3%) patients were managed by Orotracheal intubation, only 4 (6.7%) patients were managed by tracheostomy.

Fig 5: Mode of airway of studied patients



Distribution of single or multiple risk factors among patients were listed in Fig 6. 28 (46.67%) patients had a single Risk factor while 32(53.33%) patients had developed Multiple Risk factors.

Fig 6: Distribution of single & multiple risk factors among patients



Distribution of cases according to risk factors for ventilator associated pneumonia (VAP) is listed in Table 1. Stroke with hypertension, being the major risk factor involving (28.33%) cases, next in the line were Septicemia with acute kidney injury(11.67%), Diabetes with CVA(8.33%), Alcoholic liver disease(6.67%), Chronic kidney disease(5.00%), Acute bacterial meningitis, Bronchial asthma

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and Congestive cardiac failure each of these (3.33%) and Autoimmune hepatitis with shock, Colostomy for perforation, HELLP syndrome with mods, Op. Case of intestinal obstruction, Op. Case of diabetic foot, Op. Case of hemiarthroplasty rt hip, Op. Case of intestinal perforation, Potts spine with paraplegia, sepsis, and Valvular heart disease with MI (1.67%) each.

Table 1: Distribution of cases according to risk factors

Clinical Diagnosis	Number of cases (N=60)	Percentage
Stroke with hypertension	17	28.33
Septicemia with acute kidney injury	7	11.67
Diabetes with CVA	5	8.33
Op. Case of craniotomy for sol	5	8.33
Alcoholic liver disease	4	6.67
Chronic kidney disease	3	5.00
Acute bacterial meningitis	2	3.33
Bronchial asthma	2	3.33
Congestive cardiac failure	2	3.33
Interstitial lung disease	2	3.33
Op. Case of buccal carcinoma	2	3.33
Autoimmune hepatitis with shock	1	1.67
Colostomy for perforation	1	1.67
Hellp syndrome with mods	1	1.67
Op. Case of intestinal obstruction	1	1.67
Op. Case of diabetic foot	1	1.67
Op. Case of hemiarthroplasty rt hip	1	1.67
Op. Case of intestinal perforation	1	1.67
Potts spine with paraplegia,sepsis	1	1.67
Valvular heart disease with MI	1	1.67

Distribution of Clinical pulmonary infection (CPI) Score was mentioned in Table 2. Only 6 cases were placed under CPI Score 7, 21 patients under Score 8 and remaining 30 patients were categorized under CPI score 9.

Table 2: Distribution of Clinical pulmonary infection (CPI) Score in studied patients

Clinical pulmonary infection Score	Number of cases (N=60)	Percentage
7	06	10.0
8	24	40.0
9	30	50.0
Mean± SD	8.4 ± 0.7	

Pugin et al[22] created the Clinical Pulmonary Infection Score based on sputum smear microscopy and tracheal aspirate culture, as well as on the clinical findings at the time of diagnostic suspicion. It was developed to serve as a surrogate tool to facilitate the diagnosis of ventilator-associated pneumonia (VAP). Clinical pulmonary infection scoring (CPIS) was shown in table 3. In temperature, 29(48.3%) cases were recorded in score 2, 31 (51.7%) patients in score 1 while none in score 0. Under Leukocytosis 31(51.7%) were in score 1 followed by 28(46.7%) in score 2 least were in score 0 1(1.67%). Tracheal secretions recorded 32(53.33%) in score 2 followed by 28(46.7%) & none 0(0%) in score 0. Oxygenation was recorded for score 0 and Score 2 i.e. 55(91.67%) & 5(8.33%). Under Chest Radiograph & Culture Results for score 0, 0(%) was observed, score 1 have 10(16.7%) &4(6.7%) and for score 2, 50(83.3%) &56(93.3%) was recorded.

Table 3: Clinical pulmonary infection scoring

Clinical pulmonary infection score	0No. of cases(%)	1No. of cases(%)	2No. of cases(%)
Temperature (°C)	0(0%)	31(51.7%)	29(48.3%)
Leukocytosis (cells/mm cube)	1(1.67%)	31(51.7%)	28(46.7%)
Tracheal secretions (subjective visual scale)	0(0%)	28(46.7%)	32(53.33%)
Oxygenation PaO2/FIO2	55(91.67%)	-	5(8.33%)
Chest Radiograph	0(0%)	10(16.7%)	50(83.3%)
Culture Results: Tracheal Aspirate growth	0(0%)	4(6.7%)	56(93.3%)

Temperature (°C) 36.5 - 38.4 (Score 0), 38.5 - 38.9 (Score 1), ≤ 36 or ≥ 39 (Score 2); Leukocytosis (cells / mm cube) 4000 - 11,000 (Score 0), < 4000 or > 11,000 (Score 1), ≥ 500 band cells (Score 2). Tracheal secretions (subjective visual scale) None (Score 0), Mild/ non-purulent (Score 1), purulent (Score 2). Oxygenation PaO2/FIO2,> 240 (Score 0), ≤ 240 (Score 2); Chest Radiograph, No infiltrate (Score 0), Diffuse patchy infiltrate (Score 1), Localized infiltrate (Score 2); Culture, No or mild Growth (Score 0), Moderate or Florid Growth (Score 1), Pathogen consistent with Gram Stain (Score 2);

Distribution of Gram Stain of Nasotracheal/Orotracheal aspirate of studied patients was shown in Table 4. Acinetobacter Spp 27(45%) was the most prominent micro organism followed by Klebsiella pneumonia 17 (28.3%), MDR 14 (23.3%). Citrobacter spp & Pseudomonas aeruginosa exhibited same frequency 5 (8.3%). Least were Escherichia coli 3(5.0%), Haemophilus influenza 2(3.3%), Staphylococcus Aureus 1(1.7%).

Table 4: Distribution of Gram Stain of Nasotracheal / Orotracheal Aspirate of studied patients

Gram Stain of Nasotracheal/ Orotracheal Aspirate	Positive (%)	Negative (%)
Acinetobacterspp	27(45%)	33(55%)
Klebsiellapneumoniae	17(28.3%)	43(71.7%)
MDR	14(23.3%)	46(76.66)
Citrobacterspp	5(8.3%)	55(91.7%)
Pseudomonas aeruginosa	5(8.33%)	55(91.67%)
Escherichia coli	3(5.0%)	57(95.0%)
Haemophilus influenza	2(3.3%)	58(96.7%)
Staphylococcus Aureus	1(1.7%)	59(98.3%)
Staphylococcus epidermidis	0(0%)	60(100%)
streptococcus pneumoniae	0(0%)	60(100%)
Proteus	0(0%)	60(100%)
Others	0(0%)	60(100%)

The sensitivity & resistivity pattern of antibiotics among patients were shown in Table 5. Piperacillin with Tazobactum was the most sensitive antibiotic amongst 28 (46.7%) patients while the most resistant antibiotic is ciprofloxacin (40%).

Table 5: Sensitivity & Resistant of antibiotics among patients

Antibiotics	Sensitive	Resistant
Gentamycin	10(16.7%)	5(8.3%)
Norfloxacin	6(10%)	9(15%)
Amikacin	7(11.7%)	11(18.3%)
Impenem	13(21.7%)	12(20%)
Ceftazidime + Tazobactum	3(5%)	9(15%)
Ceftazidime + Clavulanate	8(13.3%)	10(16.7%)
Amoxycillin + Clavulanate	16(26.7%)	3(5%)
Piperacillin + Tazobactum	28(46.7%)	3(5%)
Ciprofloxacin	0(0%)	24(40%)
Clindamycin	2(3.3%)	2(3.3%)
Cotrimaxozole	1(1.7%)	7(11.7%)
Vancomycin	1(1.7%)	0(0%)
Linezolid	1(1.7%)	1(1.7%)
Colistin	3(5%)	2(3.3%)
Tigecycline	1(1.7%)	6(10%)
Chloramphenicol	2(3.3%)	1(1.7%)
Erythromycin	3(5%)	23(38.3%)

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DISCUSSION

VAP contributes to approximately half of all cases of hospital-acquired pneumonia.[11] Though the fundamental problem with the diagnosis of VAP is the lack of an internationally accepted gold standard, the CPIS has been most successfully used in guiding treatment for patients with a low likelihood of VAP. CPIS-guided therapy has resulted reduced development of antimicrobial resistance.

Gadani H et al in 2010 studied all patient on ventilator and found the age group between 40-60 years of age.[12] Ibrahim EH et al in 2000 studied VAP cases in medical and surgical ICU in age group of 18-75 years and found the age group between 45-60 years of age.[13] In our study we found that age group of 36-66 years were more prone for VAP. 26.7% were in age group of 36-45 years, 21.7% were in age group of 46-55 years and 18.3% were in age group of 56-65 years.

Akca et al in 2000 reported male involvement around 63.9% with VAP.[14] Saroj Golia et al in 2013 found incidence of VAP is more in men (65.4%) than females (34.61%).[15] Usman SM et al also reported male dominance (65%) in his study.[16] In our study we also found that out of 60 cases, male constituted 68.3% and female constituted 31.7% which supports above mentioned studies.

Saroj golia et al in their study found that early onset VAP was in 44.2% cases and late onset VAP was in 55.77% cases.[15] Mohan et al in 2013 found that early onset VAP occurred in 43% cases while late onset in 56% cases.[17] These were supported by our study where we found 25 % were early onset VAP and 75% were late onset VAP.

Chandrakanth C et al in 2010 in prospective study reported that 32% cases with VAP had hypertension, 29% had diabetes.VAP was found to be higher in cases with hypertension.[18] Kuo –Tung et al in 2010 found maximum cases of VAP with underlying disease of hypertension (28.6%), diabetes with cerebrovascular accident (26.2%).[19] Mohan et al in 2013 found VAP was associated with hypertension in (25%) cases.sepsis in (22.9%) cases.[17] Our study showed stroke with hypertension (28.3%) to be most found risk factor associated with VAP followed by sepsis (11.7%) and diabetes (8.3%).

Ali Shamshad et al reported that Major pathogenic bacteria isolated were Gram negative (74%), E. coli, Pseudomonas, Klebsiella and Acinetobacter were the commonest organisms.[20] Mohan et al in 2013 isolated Acinetobacter Species in 26 cases and klebsiella pneumoniae in 9 cases from 48 patients.17 A study done by Rajesh Chawla et al (21) in 2008 found that most common etiology of VAP in india was Acinetobacter species (38%) followed by klebsiella pneumoniae (23%) which also was well correlated with our study where we found that Gram-negative organisms were the most common associated pathogens. Acinetobacter spp (45%) and klebsiella pneumoniae (28.3%) being the most common organisms isolated in the patients with VAP.

Piperacillin and tazobactum was sensitive in 46.7% cases followed by amoxicillin and clavulanate in 26.7% cases which is very well correalated with study done by Saroj golia et al in 2013 where piperacillin and tazobactum was sensitive in 75% cases.[15]

CONCLUSION

In conclusion the present study showed a gradual increase in VAP along with the duration of stay in ICU. Most of the affected patients were in 4th decade with male predominance. Acinetobacter Spp (45%) was the most prominent pathogen that was responsible for VAP. Piperacillin with Tazobactum was sensitive among 46.7% of the cases where as Ciprofloxacin was most resistant in 40% of the cases.

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