Original Article

# The Incidence, Risk Factors and Diagnosis of Ventilator Associated Penumonia

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**Summary:**

**Background:** The critically ill patient is at risk of developing intensive care acquired infection, with the lungs being especially vulnerable. Ventilator associated pneumonia (VAP) occurring after two days of mechanical ventilation and it is the most nosocomial infection seen in the intensive care unit .The establishment of an accurate diagnosis of ventilator associated pneumonia remains problematic and yet there is still no accepted "gold standard" for the diagnosis.

**Patients& Methods:** This is a cross section study for 328 patients admitted to intensive care unit at medical city teaching hospital. Full history, physical examination and investigation were done after 48 hours of admission according to clinical pulmonary infection score using clinical criteria (body temperature, WBC count, oxygenation, chest radiography and tracheal aspiration).Arterial blood gases were taken for all patients.

**Results:** 40 patients developed ventilation associated pneumonia out of 328 patients (12.19%) treated intensive care unit. Most patients who developed pneumonia were at extreme of age and there was no association between the disease and gender. The presence of risk factors like invasive mechanical ventilation (97.5%) nasogastric intubation (90%), tracheostomy (75%), post-operative (30%),insertion of urinary catheter (75%) unconscious patients (57.5%) and vomiting (27.5%) were found as an important risk factors .Gram negative bacteria was the most frequently observed especially pseudomonas aeruginosa (40%) klebsiella (15%)..

**Conclusion:** ventilator associated pneumonia is an important cause of mortality. The clinical pulmonary infection score was found to be the reliable method for diagnosis of ventilator associated pneumonia. There is general agreement that rapid initiation of appropriate antimicrobial therapy will improve the outcome.

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## Introduction:

Hospital-Acquired pneumonia (HAP) or (nosocomial pneumonia): refers to a new episode of pneumonia occurring at least 2 days after admission to hospital. The term includes post-operative, certain forms of aspiration pneumonia, pneumonia or bronchopneumonia developing in patients with chronic lung disease, general debility or those receiving ventilation (1). Ventilator associated pneumonia (VAP): It is a subtype of hospital-acquired pneumonia, which occurs in people who are on mechanical ventilation through endotracheal or tracheostomy tube for at least 48 hours (2). Patients in the intensive care unit (ICU) are at risk from dying not only from their critical illness but also from secondary process such as nosocomial infection. Pneumonia is the second most common nosocomial infection in critically ill patient, affecting 27 % of all critically ill patients. VAP is associated with increase in morbidity, morality, long hospital stay and costs.

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The mortality rate attributable to VAP is as high as 43 % when the causative agent was antibiotic resistant (3).Length of stay in (ICU) increased by 5-7 days (4). The cost of VAP is estimated to be an additional at least $40000 per hospital admission per patient with the disease in USA. (5) Because every patient who is intubated and receive ventilator support is at risk for VAP, making an accurate diagnosis of this disease and starting treatment is critical. Diagnosis VAP remains difficult and controversial. pugin et al. develop a composite clinical score, called the clinical pulmonary infection score (CPIS), based on six variables: temperature, blood leukocyte count, volume and purulence of tracheal secretion, oxygenation, pulmonary radiography and culture of tracheal aspirate. The score varied from 0 to 12. A CPIS of > 6 had a sensitivity of 93% and a specifity of 100%, the maximal score is initially 8-10(6).

## Patients and Methods:

The present study is cross section study was carried out between the 1st December 2007 _30 May 2008, the sample of (328)patients who were admitted to the two intensive care units in Baghdad Teaching Hospital and

Surgical Specialization Hospital[ Medical city]. Full history was taken from their relatives. The data were collected in special designed questionnaire, which included the following: (Name, Age, gender, Cause of admission in ICU, Chronic lung disease, Defect in immune defenses. (D.M., malignancy, drugs like steroids, cytotoxic...), change in level of Consciousness, Vomiting, Nasogastric intubation , Endotracheal Intubation or tracheostomy ,Ventilator (invasive or non invasive) , Post-operative, Abdominal sepsis, Chest tube , Urinary catheter ,Duration of stay in ICU , Proper hand washing and changing the gloves between contaminated patients Complete physical examination was done . All patients who had been admitted to I.C.U and received ventilation were assessed clinically and investigations were done after 48 hours of admission according to clinical pulmonary infection score (CPIS).

**Results:**

Forty patients of out of 328 admitted patients to two (I.C.U) developed ventilator associated pneumonia (VAP) .The incidence was (12.19%).The incidence varies with age, being higher in young and elderly as in (Table1). This table shows the relation between VAP and cause of admission to I.C.U with age. (P =0.002)&there was no significant difference between causes of admission & gender (P = 0.1).The admission of patients to ICU with different underlying causes, the medical causes were 21patients (52.5%) and surgical causes were 19 patients (47.5%) .The hospitalized period for patients with VAP ranged between (3 – 30) days (mean = 12.45days). After admission 37 patients (92.5%) were developed VAP which occurred 96 hours (late onset VAP) and just 3patients (7.5%) developed early onset of VAP (48 - 96 hr). The microbiological causes are different, in the early onset VAP streptococcus spp. and staphylococcus aureus were found, while in late onset VAP more than 96 hr, the type of microorganism were pseudomonas, klebsiella, acinetobacter, staphylococcus, proteus and streptococcus. The pseudomonas aeruginosa was most frequently observed (40%), followed by klebsiella (15%), klebsiella plus pseudomonas (4%) staph. aureus (4%). streptococcus spp. (2%), Acinetobacter (2%), E coli (1%), streptococcus, plus klebsiella (1%) and normal flora (1%). Table (2) shows the risk factors according to host-related, unconscious patients were 23 (57.5 %) and conscious patients were17 (42.5%), post – operative Patients 12 (30%), vomiting 11 (27.5 %), abdominal sepsis 7 (17.5%) chronic lung disease 6 (15%), immunosuppressant disease like diabetes mellitus, malignancy 5 (12.5%), and medications like steroid and cytotoxic drugs were 5 (12.5%). The risk factor according to device related. nasogastric tube was 36 patients (90%),tracheostomy was 30 ( 75%), endotracheal tube was 10 (25%) ,chest tube was 12 ( 30%), urinary catheter 30 (75%) invasive mechanical ventilation 35 ( 87.5%), and non –invasive was 5 (12.5%) as show in (Table3). The patients who had fever between (38.5-38.9) were 14 (35%). Fever more than 39 or less than 36 were 12 (30%) temperature apart from these ranges were14 (35%). Leukocytosis less 4000 and more than 11000was 32 patients (75.5%). Localized infiltration was 23 patients (57.5%). Patchy or diffuse infiltration was 11(27.5%). Progression of infiltration was 15%. Moderate or heavy growth was 31 (77.5%). No or mild growth 6 (22.5 %). (Table4). There also relation between degree of temperature with clinical pulmonary infection score (CPIS) was significant p = 0.0001 .and between W.B.C counts with (CPIS) (P = 0.0003) and oxygenation status (pao2 / fio2 250) with (CPIS). (p = 0.018) and between growths of bacteria with CPIS (p = 0.00001). The number of patients had score > 6 been 24 patients (60%) and number of patients had score < 6 been 16 patients (40%).

**Table (1); Relation between VAP, cause of admission, age & gender.**

| | Cause of admission | No, VAP Patients* | Mean age | Male ** | Female ** |
|---|---|---|---|---|---|
| | | | | No, (%) | No,(%) |
| 1 | ROAD TRAFFIC ACCIDENT | 2 | 21.0 | 2(100) | 0(0.0) |
| 2 | RESPIRATORY FAILURE | 4 | 47.7 | 4(100) | 0(0.0) |
| 3 | POST-OPERTIVE | 3 | 63.3 | 1(33.3) | 2(66.7) |
| 4 | BLAST INJURY | 8 | 28.5 | 7(87.5) | 1(12.5) |
| 5 | STATUS EPILPTICUS | 2 | 21.0 | 1(50.0) | 1(50.0) |
| 6 | GULLIN BARRE SYNDROM | 9 | 15.2 | 8(88.9) | 1(11.1) |
| 7 | MYASTHENA GRAVIS | 2 | 36.0 | 1(50.0) | 1(50.0) |
| 8 | PUL. EMBOLISM | 2 | 26.0 | 2(100.0) | 0(0.0) |
| 9 | CERVICAL CORD INJURY | 1 | 38.0 | 1(100.0) | 0(0.0) |
| 10 | BULLET INJURY | 4 | 24.7 | 4(100.0) | 0(0.0) |
| 11 | MENINGITIS | 1 | 7.0 | 0(0.0) | 1(100.0) |
| 12 | MYOCA. INFARCTION | 1 | 57.0 | 1(100.0) | 0(0.0) |
| 13 | CA. THYROID | 1 | 60.0 | 1(100.0) | 0(0.0) |
| | TOTAL | 40 | 31.5 | 33(82.5) | 7(17.5) |

***P= 0.002**

**** Fisher's Exact Test P= 0.1**

**Table2: Risk factor according to host- related**

| Risk factor | | Number | % |
|---|---|---|---|
| Chronic lung disease | | 6 | 15% |
| Immunosuppressant | | 5 | 12.5% |
| Post – operative | | 12 | 30% |
| Abdominal sepsis | | 7 | 17.5% |
| Conscious level | Conscious | 17 | 42.5% |
| | Unconscious | 23 | 57.5% |
| Medications | | 5 | 12.5% |
| Vomiting | | 11 | 27.5% |

**Table3: Risk factor according to device- related**

| Risk factor | Number% |
|---|---|
| Endotracheal tube | 10 (25 %) |
| Tracheostomy | 30(75 %) |
| Nasogastric tube | 36 (90%) |
| Chest tube | 12 (30 %) |
| Urinary catheter | 30 (75 %) |
| Invasive ventilation | 35(87.5 %) |
| Non-Invasive ventilation | 5(12.5 %) |

**Table4: Diagnoses of (VAP) according to clinical pulmonary infection score (CPIS).**

| Score | Number (%) | P value |
|---|---|---|
| Fever | | |
| > 38.5 but < 38.9 | 14(35%) | 0.0001 |
| > 39 or < 36 | 12(30%) | |
| Leukocyte count | | |
| | 23(57.5%) | 0.003 |
| Oxygenation | | |
| Pao2 / Fio2 < 250 &no ARDs | 29(72.5%) | 0.018 |
| Chest radiography | | |
| Localized infiltration | 23(57.5%) | 0.00001 |
| Patchy or diffuse infiltrate | 11(27.5%) | |
| Progression of infiltrate | 6(15%) | |
| Tracheal aspiration | | |
| Moderate or heavy growth | 31(77.5%) | 0.005 |

**Discussion:**

In this study the incidence of those who developed VAP was (12.19%) while in a study done by (Fagon TY et al., Vanhemsp et al..Richands M Jet al.) The incidence ranges from (6.8%) to (27%).The incidence was variable in the different studies, which may be justified by the presence of different population with variable age, underlying diseases and risk factors. (6, 7, 8). The patients were admitted to I.C.U because of different causes, medical causes (21 patients) (52.5%) and surgical causes (19 patients) (47.5%).The incidence of VAP in medical causes was higher than surgical causes but not statistically significant. This agree with study done by (Kollef et al 1988) reported that the rate of pneumonia was higher in medical I.C.U but different is not significant .possibly because the medical diseases need longer mechanical ventilation. (7)The length of stay according to the type pneumonia, before 96 hr was 3 patients (7.5%) and after 96hours was 37 patients (92.5%).Late onset VAP is much higher than early onset VAP and the sputum culture in early onset VAP yield gram positive similler community acquired pneumonia .while in late onset VAP sputum cultures show predominantly pseudomonas 16 (40%), klebsiella 6 (15%) E.coli 1 (2.5%) and acintobacter spp. 2 (5%). The causative agents of VAP differ by the study population and diagnostic techniques but generally Gram negative bacteria are the most common ones (Pugin J et al. Ewing et al.) (12).Colonization of oropharynx , trachea and stomach with gram –negative pathogens has been identified (center for Disease Control and prevention) also in this study we found that gram –negative pathogen were the most common, further more prior antibiotic therapy leading to colonization with gram-negative pathogens were reported as a risk factor for VAP (Memish Z A et al. ) (13). Mechanical ventilation increases the risk of VAP (35) patients (87.5%) with invasive ventilation and 5 patients (12.5%) with non-invasive ventilation .Consequently, the use of non-invasive ventilation should be preferred whenever possible, since it has lower rates of VAP. Mechanical ventilation increase the risk of VAP by 3 to 10 folds this agree with study done of Fagon T.Y et al .1993, chastre G (14, 15, 16). Coma was described as another important risk factor for VAP, unconscious patients were 23 patients (57.5%) and conscious patients were 17 patients (42.5%).In these patients, local defense mechanisms of the respiratory airway altered allowing the microorganism to colonize in the mucosal surfaces .In our study comatose patients had increase the risk of VAP by 1.35%. Which is agreeable to another study Ewing S et al.) who concluded that depression of the level of consciousness increases significantly the chance of aspiration and the development of VAP (17, 18 19). Also we found that 90 % of patients with VAP had nasogastric tube which may impair the function of gastroesophageal sphincter ,increase the gastric distension ,colonization and aspiration pneumonia .The result that is nearly similar to a study done by George et al . Who reported that 75% of patients with VAP had nasogastric tube (18, 19). A study reported by Ewing S et al . that patients with tracheostomy had 7 fold increases risk of VAP .We found that (75 %) of patients with tracheostomy and (25%) of patients with endotracheal tube (25%) developed VAP .Therefore the tracheostomy is described as a significant risk factor for VAP .probably due to colonization during procedure and prolong continuation of sedation after procedure.We also found that other important risk factor which are responsible for development of VAP like vomiting ,post-operative ,abdominal sepsis , immunosuppressant diseases like D.M and malignancy and drugs like steroid and cytotoxic drug (11,12.13.16.17). The clinical pulmonary infection score (CPIS) used to support the diagnosis and improve the empirical treatment .In our study number

of patients had > 6 points was 24 (60%) and patients had < 6 points was 16 (40%). There is significant association between CPIS with the clinical variable (body temperature, W.B.C count, oxygenation, CXR finding and growth of pathogens) to assess the accuracy of score for diagnosis of VAP.P-values of these variables are significant as shown in table (4).

**Conclusion:**

1- This study showed that young & old people are susceptible to VAP; and this may be explained by the coexistence diseases.

2- VAP Late onset is much high than early onset VAP .Gram negative bacteria especially pseudomonas was the common pathogen in late onset pneumonia and streptococcus was common pathogen in early onset VAP.

3- Coma, surgery, nasogastric tube, tracheostomy, invasive mechanical ventilation, urinary catheter, chest tube and vomiting are common host and devised-related risk factor.

4- Clinical variable in CPIS (temperature, W. B.C count, oxygenation, CXR and growth of bacteria) were good parameters for diagnosis VAP in this study.

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