Original Research Article

INCIDENCE,RISKFACTORSANDMICROBIOLOGICALPROFILEOFVENTILATOR ASSOCIATEDPNEUMONIAPATIENTSINICUINTERTIARYCAREHOSPITAL

ABSTRACT

Background:VAP,orventilator-associatedpneumonia,isoneofthemostcommonICU-acquired diseases and a significant cause of mortality among ICU patients (ICU). InfectiousillnessesarecurrentlyunderestimatedintheSouth AsianRegion,whichhaslimitedhealthresources.

Objective: To examine the incidence of VAP, risk factors associated and the microbiologicalprofile in ICU patients in tertiary care hospitals.

Methods: A total of 114 patients under mechanical who satisfied all inclusion criteria wereselected. Detailed history, investigations were undertaken. The diagnosis of VAP was madeaccording to clinical and laboratory findings (as per CDC criteria) and incidence was derivedfrom the number of patients developing VAP out of the total number of patients on ventilatorysupport in ICU.

Results: We included 114 patients in our study. Out of 114 patients, the majority were above 70yearsagegroupMeanageofstudypopulationwas61.29±13.42years.Outof114,80patients i.e. 70.2% were males and 34(29.8%) were females. Male: female ratio was 2.3:1. KlebsiellaPneumoniawasacommonlyobservedorganisminculturesi.e.30.7%,followedbyPseudomonas Aeruginosa in 27.2% and Acinetobacter Baumaniin 19.3%. Antibiotic sensitivitypattern of Klebsiella Pneumonia showed resistance to Carbapenemase in 20(57.1%) cases and toESBL in 15(42.9%) cases. Death rate in our study was 17.5%

Conclusion: TheoutcomeofVAPdependsonrapididentificationofthecausativemicroorganism. Empirical therapy based on knowledge of the most prevalent microorganismsand their resistance pattern has an impact on lowering morbidity and mortality, shortening thelength of hospital stay, lowering of treatment expenses, and prevents the development of MDRbacteriainpatients withVAP.

KEYWORDS: Ventilator-associatedpneumonia,~~VAP,~~ICU,~~KlebsiellaPneumonia,Acinetobacter~~

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~~Baumani, Carbapenemase~~

INTRODUCTION

Ventilator-associated pneumonia (VAP) is defined by infection of the pulmonary parenchyma inpatients exposed to invasive mechanical ventilation for at least 48 h and is part of ICU-acquiredpneumonia.VAPremainsone of the most common infections in patients requiring invasivemechanical ventilation. Despite recent advances in microbiological tools, the epidemiology anddiagnostic criteria for VAP are still controversial, complicating the interpretation of treatment,prevention, and outcomes studies. VAP imposes a significant economic burden. A recent costevaluationfromtheUSAestimatedthattheattributablecostofVAPtobe$40,144(95%CI $36,286–$44,220).[1,5]

The principal risk factor for the development of VAP is endotracheal tube, which predispose tomicro aspiration of contaminated oropharyngeal secretions. Duration of mechanical ventilation,supinepatientpositioning,enteralfeeding,modifiablefactorsassociatedwithprolongedintubationsuchasoversedationorlackofprotocoldrivenweaningincreasestheriskofdevelopingpneumonia.[2]

Ventilator associated Pneumonia is categorized as early onset, if the infection occurs within firstfour days of mechanical ventilation and late onset if it occurs from 5th day onwards. Early onsetiscommonlycausedby antibiotic sensitive, community acquired organisms, whereas late onsetis caused by multiple drug resistant nosocomial strains. Early onset pneumonia is likely to becausedbyStaphylococcusaureus,Streptococcuspneumoniaeor*Haemophilusinfluenzae*,whereaslateonsetiscausedbymultidrugresistantstrainsof*Pseudomonasaeruginosa*,*Acinetobacter*or *Methicillin resistantStaphylococcus aureus* (MRSA).[1,2]

TheincidenceofVAPoccursin9-27%ofmechanicallyventilatedpatientswithabout5casesper1000 ventilator days. The etiologic agents of VAP include common nosocomial pathogens suchas Pseudomonas spp, Acinetobacter and other non-fermenters, members of Enterobacteriaceaefamily,Staphylococcus andCandida sps.[3,4]

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VAPshouldratherbesuspectedinpatientswithclinicalsignsofinfection,suchasatleasttwoofthe followingcriteria:newonsetoffever,purulentendotrachealsecretions,leucocytosisorleukopenia,

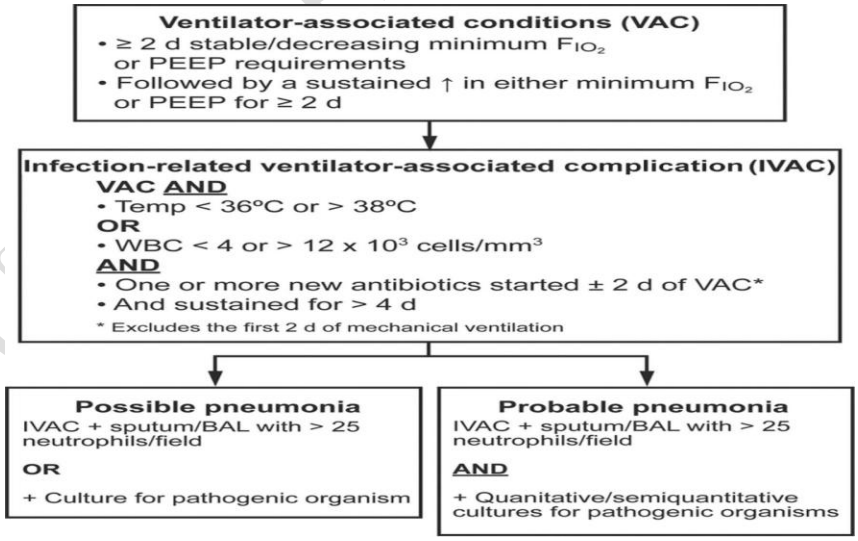
increase in minute ventilation, decline in oxygenation, and/or increased need for vasopressors tomaintainbloodpressure.ThesesignsarenotspecificforVAP,however,andcanoftenbeobservedin the many conditions that mimic VAP (e.g., pulmonary edema, pulmonary contusion, pulmonaryhemorrhage,mucousplugging,atelectasis,thromboembolicdisease,etc.).

Although almost all definitions for suspecting (and diagnosing) VAP include radiographic criteria(new or progressive and persistent infiltrates), it is well known that chest X-rays are neither sensitivenorspecificforVAP.[6]

In the new VAE model, before considering VAP as a diagnosis, certain precursor clinical eventsmust be fulfilled. It includes objective criteria related to lung deterioration of lung function i.e.ventilator associated condition (VAC) and its incidence with lab values and institution of (or changesin)antibioticadministration(infectionrelatedventilatorassociatedcomplication(IVAC).

Both VAC and IVAC constitute VAE and are intended for public reporting purposes. Once theseconditions have been met, varying amounts of microbiological evidence may occur within 2 daysprior to or following deterioration of pulmonary functions that used to make diagnosis of eitherpossible or probable VAP. Both possible and probable VAP will likely be limited to intra-institutionalqualityimprovementmeasurements.

List1. ventilator associated condition model



Detection of the etiologic agents is crucial for the diagnosis of VAP which is done by collectingthelower respiratory tract sample either by invasive methods like protected specimen brush(PSB)andbroncho-alveolarlavage(BAL)ornon-invasivetechniquesendotrachealaspirate(ETA). For diagnosis of VAP, quantitative/semi-quantitative culture of endotracheal aspirate orbronchoscopic aspirates from the infected lungs segments are recommended for the optimizationofantibiotic use.[4]

Hence the present study is one of the first studies in India (Pre covid era) with the objective toassess the incidence, risk factors and microorganisms causing ventilator associated pneumoniausing the new criteria as mentioned above.

MATERIALSANDMETHODS

Study population: ICU patients on mechanical ventilation

Study period: The study duration is for a period of 1 year 6 months. (November 2018 to April2020)

Studydesign: Hospitalbasedprospectiveobservationalstudy.

Sampling technique: Simple random sampling method

Inclusion criteria:

AllICUPatientsabovetheageof18yearsofeithergenderwhowillbereceivingmechanicalventilation, then developed ventilator associated pneumonia are included in this study

Exclusion criteria:

- Age< 18 years
- PatientsdevelopinganewlesioninCHESTX-RAYwithin48hoursaftermechanicalventilation
- Patients who have recent surgery are excluded from surgery

Variablesusedinstudy: Age,gender,VAPmicroorganisms,riskfactors

Methods of data collection:

Data was collected using a pretested proforma meeting the objectives of the study. Detailedhistory, investigations was undertaken. The purpose of the study was explained to the patient andtheir attendants and informed consent will be obtained.

Patientswereselectedforstudywhosatisfiedall inclusion and exclusion criteria. Relevanthistoryincludingsymptomsandsignsatpresentation,pastmedicalhistoryandclinicalexamination findings arenoted.

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Thediagnosis of VAP was made according to clinical and laboratory findings (as per CDCcriteria) and incidence was derived from the number of patients developing VAP out of the totalnumber of patients on ventilatory support in ICU.

INVESTIGATIONS

- Haemogram includes TC, DC, Haemoglobin%, Erythrocyte sedimentation rate
- Renalfunctiontest,includesbloodurea,serumcreatinine,Serumelectrolytes,includessodium, potassium and chloride levels.
- Liver function test
- CHESTXRAY.
- HRCT CHEST

Bronchoscopy and Broncho alveolar lavage and culture – Bronchoscopy was done - when ETaspiratesterile -focal infiltrate foundon Chest X-ray.

FollowingRiskFactorsforVAPwerestudied-Numberofintubationsanddurationofintubation, aspiration at the time of intubation, duration of mechanical ventilation, tracheostomy,use of nasogastric tube feeding, use of sedative drugs, comorbid conditions like DM, emergencyorelective surgeries, sepsis.The patients werefollowed up till dischargefrom ICU.

Ethical Clearance:

Ethical Clearance was obtained from the Institutional Scientific review board and ethicscommitteeprior to the commencementof the study.

Statistical analysis and methods:

Datawascollectedbyusingastructureproforma.DatathuswasenteredinMSexcelsheetandanalysed by using SPSS 24.0 version IBM USA.

Apvalueof<0.05wasconsideredasstatisticallysignificantwhereasapvalue<0.001wasconsidered as highly significant.

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RESULTS AND DISCUSSION

We included 114 patients in our study. Out of 114 patients, majority were above 70 years agegroup i.e. 31(27.2%), followed by 30(26.3%) from 61-70 years age group, 26(22.8%) from 51-60years age group. Least was found in less than 40 years age group i.e. 7% only. Mean age of studypopulation was 61.29±13.42 years.Incidence of early VAP in our study was 34.2% and late

VAPwas 65.8%. Incidence of VAP in our study was calculated per 1000 VAP days per 750 patientsduring the study period who required mechanical ventilation and admitted in ICU. Out of 750patientsonventilator,114developedVAPandthemeandurationofICUstaywas12days.(114*1000) /(750*12) = 12.7 per 1000 VAP days.The incidence thus calculated is 12.7 per1000 VAP days.~~.~~ The VAP thus again further divided depending on duration of occurrence intoearly and late VAP. Clinical characteristics of host factor revealed diabetes as most commonfactor in 102 i.e. 89.5% of patients, followed by AKI in 61 (53.5%), chronic lung disease in27(23.7%),immunocompromisedstatusin26(22.8%), ARDS in 18(15.8%), poor nutritionalstatus in 17(14.9%) and liver failure as well as CVA in 4 patients each i.e. 3.5%. CKD was themostcommonlyseencomorbidityinourstudyi.e.27.2%.Prevalenceofcomorbiditiesindecreasing order are CKD in 27.2%, HTN in 25.4%, old CVA in 20.2%, COPD in 18.4%, CADin 8.8%, rheumatism in 1.8% and asthma in 0.9%

*Klebsiella p~~P~~neumonia*was commonly observed organism in cultures i.e. 30.7%, followed by*Pseudomonas a~~A~~urgeinosa~~in~~*(27.2%) and *Aceinobacterb~~B~~aumani~~in~~*(19.3%).Antibiotic sensitivitypattern revealed resistance to Carbapenemase in majority of the patients i.e. 59(51.8%), followedby resistance to ESBL in 19(16.7%) and 11 i.e. 9.6% to both.Antibiotic sensitivity pattern of*Klebsiella p~~P~~neumonia*showed resistance to Carbapenemase in 20(57.1%) cases and to ESBL in15(42.9%) casesAntibiotic sensitivity pattern of *Pseudomonas a~~A~~urgeinosa*showed resistance toCarbapenemasein31(58.1%)cases.Antibioticsensitivitypatternof*Aceinobacterb~~B~~aumani*showed resistance to Carbapenemase in 21(95.5%) cases.Antibiotic sensitivity pattern of *Staph~~a~~Aureus* showed resistance to B-lactams - Modification of PBP in 3 patients i.e. 75%.

Most common age group in early VAP was 41-50 (28.2%) and 51-60 (30.8%) whereas mostcommon age group in late VAP was 61-70 (33.3%) and above 70 (29.3%). The difference intheproportionofcasesbetweenearlyandlateVAPwasstatisticallysignificant(p<0.05)

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Percentage of males affected in early VAP were 64.1% compared to 73.3% in late VAP(<0.05). Percentage of females affected in early VAP were 35.9% compared to 26.7% in lateVAP(<0.05)

Poor nutrition status was seen in 15.4% cases of early VAP compared to 14.7% of late VAPwhichisa statistically significant difference (p<0.05). Chronic lung disease was seen in28.2% cases of early VAP compared to 21.3% of late VAP which is a statistically significantdifference (p<0.05). DM was seen in 84.6% cases of early VAP compared to 92% of lateVAP which is a statistically significant difference (p<0.05). Depressed level of consciousnesswasseenin10.3%casesofearlyVAPcomparedto21.3%oflateVAPwhichisastatisti callysignificant difference (p<0.05). AKI was seen in 43.6% cases of early VAP compared to58.3% of late VAP which is a statistically significant difference (p<0.05). ARDS was seen in12.8% cases of early VAP compared to 17.3% of late VAP which is a statistically significantdifference (p<0.05). Liver Failure was seen in 2.6% cases of early VAP compared to 4% oflate VAP which is a statistically significant difference (p<0.05). CVA was seen in 4 % of lateVAP which is a statistically significant difference (p<0.05). Immunocompromised was seenin 20.5% cases of early VAP compared to 24% of late VAP which is statistically significantdifference(p<0.05).

Comparison of comorbid conditions and its prevalence between early and late VAP wasfound to be statistically significant (p<0.05).

COPD was seen in 23.1% cases of early VAP compared to 16% of late VAP which is astatistically significant difference (p<0.05). Old CVA was seen in 12.8% cases of early VAPcompared to 24% of late VAP which is a statistically significant difference (p<0.05). HTNwas seen in 20.5% cases of early VAP compared to 28% of late VAP which is a statisticallysignificantdifference(p<0.05).CADwasseenin7.7%casesofearlyVAPcomparedto9. 3%of late VAP which is a statistically significant difference (p<0.05). CKD was seen in 15.4%casesofearlyVAPcomparedto33.3%oflateVAPwhichisstatisticallysignificantdifference(p<0.05)

Comparison of intervention factors and its prevalence between early and late VAP was foundto be statistically significant (p<0.05). Reintubation was done in 23.1% cases of early VAPcomparedto24%oflateVAPwhichisastatisticallysignificantdifference(p<0.05).Nasogastri cfeedingwasdonein94.9%casesofearlyVAPcomparedto93.3%oflateVAP

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which is a statistically significant difference (p<0.05). Sedation was carried out in 48.7%casesofearlyVAPcomparedto52%oflateVAPwhich is a statistically significantdifference (p<0.05). Stress ulcer Prophylaxis (PPI) was associated with 92.3% cases of earlyVAP compared to 94.7% of late VAP which is statistically significant difference (p<0.05)Previous antibiotic intake was seen in 84.6% cases of early VAP compared to 86.7% of lateVAP which is statistically significant difference (p<0.05). Steroids given was seen in 59%casesofearlyVAPcomparedto61.3%oflateVAPwhichisstatisticallysignificantdifference(p <0.05)

Presence of microorganisms and its difference in prevalence between early and late VAP wasfound to be statistically significant (p<0.05)

*Acinetobacter baumani*is present in 20.5% cases of early VAP compared to 18.7% of lateVAPwhichis statisticallysignificant difference(p<0.05)

*Klebsiella pneumoniae*is present in 23.1% cases of early VAP compared to 34.7% of lateVAPwhichis statisticallysignificant difference(p<0.05)

*Pseudomonas aeruginosa*is present in 28.2% cases of early VAP compared to 26.7% of lateVAPwhichis statisticallysignificant difference(p<0.05)

Outof114patients,themajorityofthepatientsweredischarged aftersuccessfulcompletionoftreatmenti.e.94patientsanddeathoccurredin20patients.Majorityofdeaths tookplacein61-70yearsagegroupi.e.9(9.6%)followedby5eachi.e.5.3%in51-60andabove70years. Majority of survivors in our study were above 51 years age group i.e. 72.3%Percentageofsurvivingmaleswere71.3%comparedto13.8%ofdeaths(<0.05).Percentageofsurvivingfemaleswere28.7%comparedto7.4%ofdeaths(<0.05).Proportionofdeathsweremoreinlate VAPi.e.17%comparedtoearlyVAPi.e.4.3%(p<0.05)

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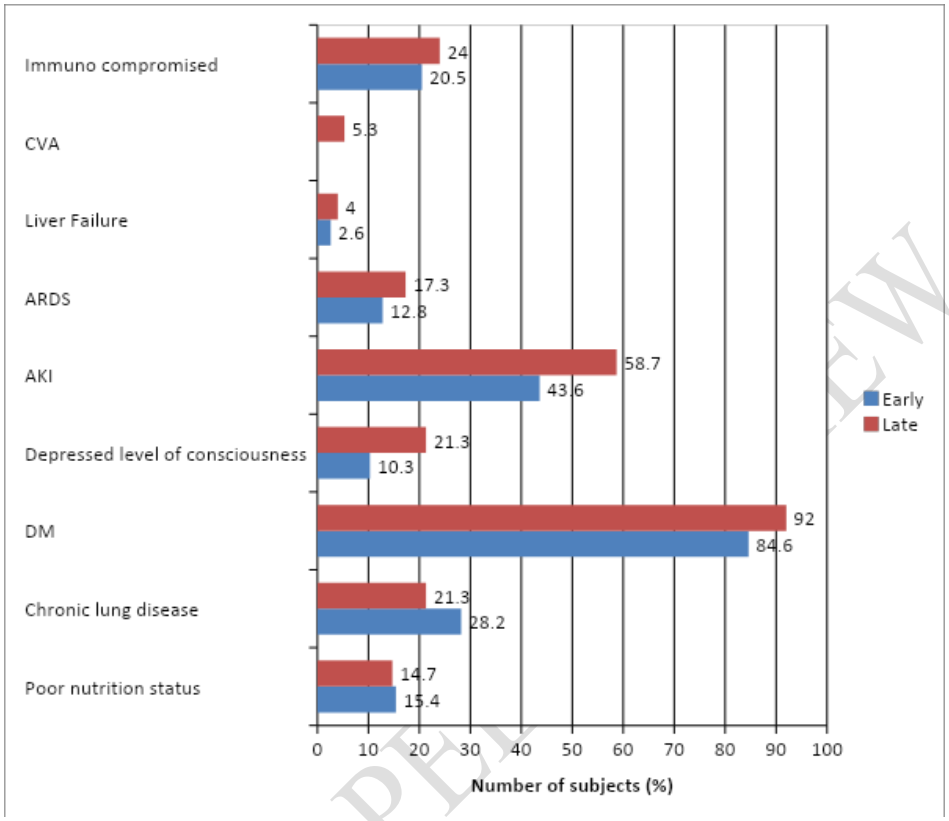

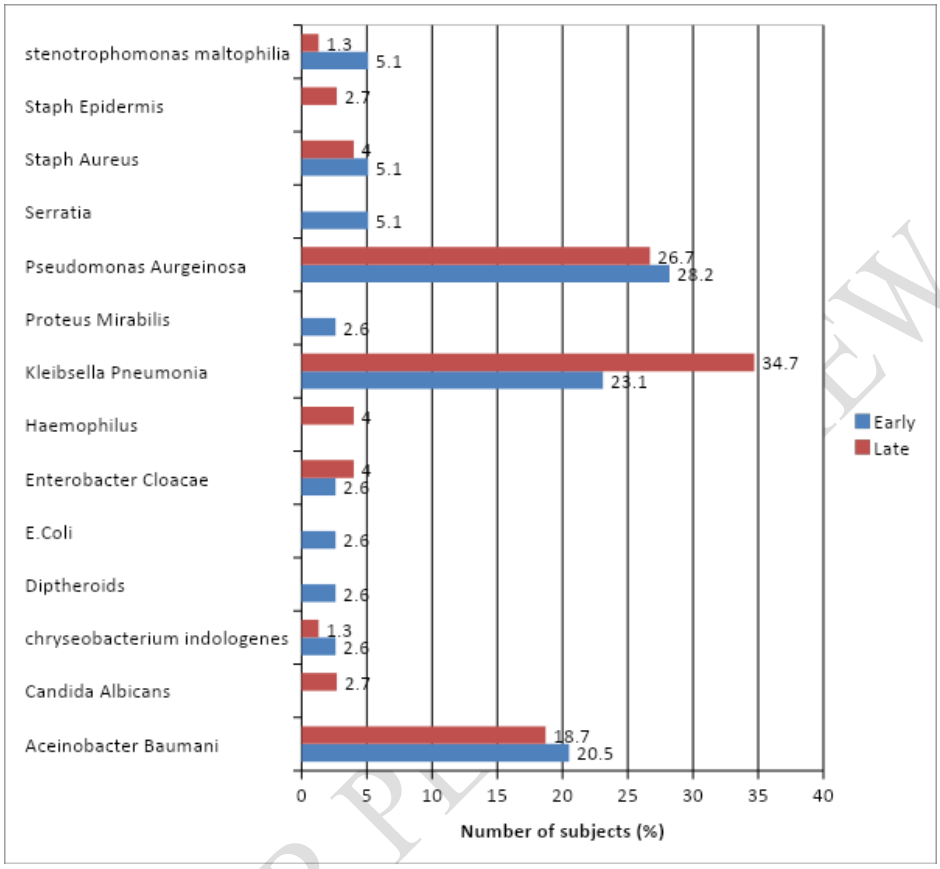

Fig 1. BardiagramshowingAssociationbetweentypeofVAPandorganismsisolated

References

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6. ~~6.~~ Mietto C, Pinciroli R, Patel N, Berra L. Ventilator associated pneumonia: evolving definitions and preventive StrategiesDiscussion. Respiratory care. 2013 Jun 1;58(6):990-1007.

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