"TO STUDY THE CLINICAL PROFILE, ETIOLOGY AND OUTCOME OF VENTILATOR ASSOCIATED PNEUMONIA. A ONE YEAR CROSS-SECTIONAL STUDY"

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Dissertation

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Under the Guidance of

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LIST OF ABBREVIATIONS USED

A baumannii	:	Acinetobacter baumannii
ARDS	:	Acute respiratory distress syndrome
ARF	:	Acute renal failure
BAL	:	Bronchoalveolar lavage.
C freundii	:	Citrobacter freundii
CFU	:	Colony forming unit
CMV	:	Cytomegalo virus
COPD	:	Chronic obstructive pulmonary disease
CPIS	:	Clinical Pulmonary Infections Care
E. Coli	:	Escherichia coli
EPIC	:	The European prevalence of infection in intensive care.
ESBL	:	Extended spectrum beta lactamase
ETA	:	Endotracheal aspirate
GBS	:	Gullain Barre syndrome
HAP	:	Hospital associated pneumonia
HCAP	:	Health care associated pneumonia
HH	:	Heater humidifiers
HME	:	Heat moisture exchange
ICU	:	Intensive care unit
LRTI	:	Lower respiratory tract infection
MICU	:	Medical Intensive Care Unit
MRSA	:	Methicillin resistant staphylococcus aureus
MSSA	:	Methicillin sensitive staphylococcus aureus
MV	:	Mechanical ventilation

NIV	:	Non invasive ventilation
NNIS	:	National nosocomial infections surveillance
OP Poisoning	:	Organo phosphorous poisoning
P. aeruginora	:	Pseudomonas aeruginosa
PGE_2	:	Prostaglandin E2
CVT	:	Cortical venous thrombosis
PSB	:	Protected specimen brush
R	:	Resistant
S	:	Sensitive
S. aureus	:	Staphylococcus aureus
SSD	:	Selective decontamination of digestive tract
UTI	:	Urinary tract infection
VAP	:	Ventilator associated pneumonia

ABSTRACT

Background and objectives

Hospital-associated pneumonia (HAP) is an infection of the lungs, usually due to bacterial, viral, or fungal pathogens, that is defined to occur greater than 48 hours after hospital admission. The present study was undertaken to assess clinical profile, risk factors and outcome in patients with ventilator associated pneumonia in critical care units and to find the etiology of ventilator associated pneumonia.

Methodology

The present one year cross sectional study was conducted in the Department of Medicine, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum on 53 patients with VAP during the period of January 2010 to December 2010. The diagnosis of VAP was made according to clinical and laboratory finding based on Clinical Pulmonary Infections Score.

Results

A bimodal distribution of age was observed. 35.84 % of them developed bilateral and 35.85 % of them developed right sided pneumonia. Acinetobacter was the most common organisms isolated in early VAP (47.62%) and pseudomonas (57.14%) in late VAP. Among all the patients (100%) supine position and stress ulcer prophylaxis was identified as risk factor. 90.56% of patients developed VAP with in the first two weeks. 11 of the 13 patients who were greater than 60 years expired. Mortality in late onset VAP was 59.38% and early onset VAP was 23.81%. Out of the Acinetobacter and Pseudomonas

isolated majority of them were multidrug resistant isolates. Out of the 17 isolates of Pseudomonas 47.06% of them were metallo-beta lactamase producers.

Interpretation and conclusion

The incidence of patients who are being admitted to ICU and requiring mechanical ventilation is increasing. Knowledge of incidence of VAP, risk factors and their causative microbial flora in a local setting would be important to ensure more effective utilization of antibiotics and thereby, a better outcome.

Keywords

Clinical Pulmonary Infections Score; Hospital-associated pneumonia; Ventilator associated pneumonia;

CONTENTS

LIST OF TABLES

LIST OF GRAPHS

LIST OF PHOTOGRAPHS

Chapter 1

Introduction

INTRODUCTION

Hospital-associated pneumonia (HAP) is an infection of the lungs, usually due to bacterial, viral, or fungal pathogens, that is defined to occur greater than 48 hours after hospital admission. Hospital-associated pneumonia is the second most common hospital-acquired infection but leads to the greatest number of nosocomial-related deaths.[1,2]

In addition to increased morbidity and mortality, HAP also results in extended hospital stays and is often treated with prolonged antibiotic administration, resulting in further financial burdens and antibiotic-resistance pressures on hospitals.

Ventilator-associated pneumonia (VAP), one form of HAP, specifically refers to pneumonia developing in a mechanically ventilated patient more than 48 hours after tracheal intubation.[3,4]

Time of onset of pneumonia is an important epidemiologic variable and risk factor for specific pathogens and outcomes in patients with HAP and VAP. Early-onset HAP and VAP (occurring within the first 4 d of hospitalization) usually carry a better prognosis and are more likely to be caused by antibiotic-sensitive bacteria.[5]

Late-onset HAP and VAP (occurring greater than 4 days after hospital admission) are more likely to be caused by multiple-drug resistant pathogens associated with increased hospital mortality and morbidity.[6-8] HAP and VAP represent the second most common nosocomial infection, affecting

approximately 27% of all critically ill patients.[2] HAP accounts for up to 25% of all ICU infections and more than 50% of the antibiotics prescribed.[2] VAP occurs in 9–27% of all intubated patients.[5,9] Among ICU patients, nearly 90% of episodes of HAP occur during mechanical ventilation.

In mechanically ventilated patients the incidence of VAP increases with duration of ventilation. The risk of VAP is highest early in the course of hospital stay and is estimated to be 3% per day during the first 5 days of ventilation, 2% per day during days 5–10 of ventilation, and 1% per day after this.[10] Since most mechanical ventilation is short-term, approximately half of all episodes of VAP occur within the first 4 days of mechanical ventilation.[11] The intubation process itself contributes to the risk of pneumonia,[12] and when patients with acute respiratory failure are managed with noninvasive ventilation, nosocomial pneumonia is less common.[13-15] These studies support the importance of tracheal intubation as a risk factor promoting the occurrence of VAP.

VAP is the leading cause of nosocomial mortality for patients with respiratory failure. Approximately 60% of all deaths in patients with nosocomial infections are associated with HAP[16] and the mortality rate is higher in critically ill patients and those patients developing VAP.

In these populations, mortality by all causes increases 2 to 2.5 fold, compared to patients without VAP,[17,18] and reported crude mortality rates have ranged from 20% to 70%"Attributable mortality" in patients with VAP can account for up to 50% of all mortality.[19-25]

Hence the present study was undertaken to assess clinical profile, risk factors and outcome in patients with ventilator associated pneumonia in critical care units and to find the etiology of ventilator associated pneumonia.

Chapter 2

Objectives

OBJECTIVES

The objectives of the present study were;

1. To know the clinical profile, risk factors and outcome in patients with ventilator associated pneumonia in critical care units.

2. Etiology of ventilator associated pneumonia.

Chapter 3

Review of Literature

REVIEW OF LITERATURE

Definition

Ventilator associated pneumonia is defined as the occurrence of new and persistent radiographic infiltrate not otherwise explained, appearing on chest radiograph more than 48 hours after onset of mechanical ventilation (or) within 48 hours of extubation, along with any two of the following;[26-29]

i. Body Temperature > 38.3^0 C.

ii. Leukocytosis (>10,000 WBC/mL).

iii. Purulent Tracheal aspirate.

Classification

Early- onset VAP

Ventilator associated pneumonia occurring in the first four days of endotracheal intubation and initiation of mechanical ventilation.

Late-onset VAP

Ventilator associated pneumonia developing after four days of mechanical ventilation.[30]

Epidemiology and incidence

VAP is one of the most important ICU nosocomial infections causing significant morbidity and mortality.[27]

Accurate data on the epidemiology of VAP are limited by the lack of standardized criteria for its diagnosis. Conceptually, VAP is defined as an inflammation of the lung parenchyma caused by infectious agents not present or incubating at the time mechanical ventilation was started. Despite the clarity of this conception, the past three decades have witnessed the appearance of numerous operational definitions, none of which is universally accepted.

In contrast to infections of more frequently involved organs (urinary tract and skin), for which mortality is low, (ranging from one to four percent), the mortality rate for VAP ranges from 24 to 50% and can reach 76% in some specific settings or when lung infection is caused by high-risk pathogens. Because several studies have shown that appropriate antimicrobial treatment of patients with VAP significantly improves outcome, more rapid identification of infected patients and accurate selection of antimicrobial agents represent important clinical goals.

In a study conducted in Athens, patients at a greater risk of developing VAP were identified and the incidence was found to be around eight percent among all the patients on mechanical ventilator.[27] In another study conducted in Spain, VAP was found to be more frequent in patients with ARDS (55%) than in other mechanically ventilated patients (28%).[28] In a three year retrospective study conducted in a Turkish University Hospital between Jan 2000 and Dec 2002 the incidence of VAP was found to be 20%.[30] In a prospective study conducted in Manila Doctors Hospital ICU the risk factors and clinical outcomes of late onset VAP were measured and incidence was around 19%.[31]

In an Indian study conducted in Delhi in year 2001 by HS Hira et al the authors found that 82% of the 28 ventilated patients developed VAP.[32]

The common organisms were found to be Gram negative bacilli, Klebsiella, Pseudomonas and E.coli. They concluded that the incidence of gastrointestinal aspiration was high in mechanically ventilated patients and correlation with LRTI was significant. It was also observed that the duration of ventilation was significantly related to the incidence of pneumonia.

In another Indian study in the year 2003 by Mandakini Pawar et al on 952 patients undergoing cardiac surgery, the incidence of VAP was found to be around 2.5%.[33]

Pathogenesis

The pathogenesis of VAP, as well as HCAP and HAP, is linked to two separate but related processes: colonization of the aerodigestive tract with pathogenic bacteria, and aspiration of contaminated secretions.

The most common sources of VAP pathogens are from microaspiration of oropharyngeal secretions, aspiration of esophageal/gastric contents, inhalation of infected aerosols, embolization of contaminated biofilm from the endotracheal tube surface, hematogenous spread from distant infection, exogenous penetration from the pleural space, or direct inoculation (eg, resulting from tracheal intubation).[3]

Bacterial colonization of the oropharynx is universal with *Streptococcus pneumoniae*, various anaerobes, and *Haemophilus influenzae* being found in

normal subjects. Colonization with Gram-negative bacilli, notably virulent organisms such as *Pseudomonas aeruginosa* and *Acinetobacter* species, is rare in healthy individuals.[34]

It is known that oropharyngeal and tracheal colonization with *P. aeruginosa* and enteric Gram-negative bacilli increases with length of hospital stay and with severity of illness.[35,36]

One older study noted that 35% of moderately ill patients and 73% of critically ill patients were colonized with Gram-negative bacilli.[37]The same investigators found that pneumonia occurred in 23% of colonized patients but in only 3.3% of uncolonized patients.[37,38]

Aspiration of oropharyngeal secretions is not uncommon, even in health. Approximately 45% of healthy subjects were shown in one study to aspirate during sleep,[39] and the rate of aspiration is higher than this in patients with impaired levels of consciousness and inability to protect their airways from aspiration events.[4,34] Factors promoting aspiration include an overall reduced level of consciousness, a blunted gag reflex, abnormal swallowing for any reason, delayed gastric emptying, or decreased gastrointestinal motility. Reflux and aspiration of nonsterile gastric contents is also a possible mechanism of pathogen entry into the lungs,[4,40-41] although its role is generally less important than that of oropharyngeal colonization.[42] The stomach has been particularly implicated in late-onset VAP as a potential reservoir for antibiotic-resistant bacteria.[43]

The understanding of the dual pathogenesis of VAP (colonization of the aerodigestive tract with pathogenic bacteria and their subsequent aspiration) has

allowed for the development of intervention strategies aimed at the prevention of this infection. These education-based programs have shown that the occurrence of VAP can be reduced by 50% or more, using multiple interventions aimed at preventing colonization and aspiration.[44,45] The interventions applied are semi recumbent position, prevention of gastric distension by use of prokinetics and ryle's tube insertion.[46,47]

Risk factors

Aspiration and colonization

Johanson and coworkers established that upper airway colonization is a frequent occurrence in ventilated patients and that it can act as a harbinger of nosocomial pneumonia in this setting.[48] These authors demonstrated that 45% of 213 patients admitted to a medical ICU became colonized with aerobic Gram negative bacteria by the end of 1 week in the hospital. Among the 95 colonized patients, 22 (23%) subsequently developed nosocomial pneumonia. By comparison, only four of the 118 (3.4%) noncolonized patients developed pneumonia.

"Macroaspirations" of gastric material initiate the process in some patients. Allowing condensates in ventilator tubing to drain into the patient's airway may have the same effect. Bronchoscopy, tracheal suctioning, or manual ventilation with contaminated equipment may also bring pathogens to the lower respiratory tract. More recently, concerns have focused on the potential role of contaminated medication nebulizers, but these devices are infrequently associated with VAP.[45,49]

Other sources of pathogens causing VAP include the paranasal sinuses, dental plaque, and the subglottic area between the true vocal cords and the endotracheal tube cuff. A sequence of events leading to colonization from the stomach to the trachea, with increasing frequency in direct correlation to the gastric pH, was reported by several investigators, with 27 to 45% of patients having primary colonization of the gastric juice and subsequent colonization of the tracheobronchial tree approximately two days later. In addition to those microbiologic studies, other studies have clearly proven, by means of radiolabeled gastric juice or other techniques that the gastric juice of intubated patients is aspirated into the tracheobronchial tract within a few hours.[50,51] Those investigations convincingly corroborate the microbiologic studies demonstrating that tracheobronchial colonization originates in the stomach in at least 25 to 40% of patients and, therefore, lend support to the role of the gastric barrier in the pathogenesis of nosocomial pneumonia. Whether bacteria ascend from the intestines or descend from the oropharynx, the stomach may act as a reservoir in which pathogens can multiply and attain high concentrations. Alkalinization of the normally acid gastric environment seems to be a prerequisite for this mechanism to be operational.

Aspiration is the pathogenic mechanism most frequently implicated in development of VAP. Huxley and colleagues have demonstrated that oropharyngeal aspiration was a common event both in healthy persons and critically ill patients.[39] Using a sensitive chloride method they found that aspiration occurred in 45% of normal subjects during sleep and in 70% of patients with depressed consciousness. Other investigators have reported that

risk of aspiration was seven times higher in patients with uncuffed compared with cuffed endotracheal tubes.[52]

The events that control pathogenic colonization of the airway and upper GI tract, the first step in the development of VAP are incompletely understood. In healthy persons the prevalence of aerobic Gram negative bacilli in the oropharyngeal flora was low (2%). Factors that have been associated with pathogenic colonization include hospitalization, airway instrumentation, chronic or acute illness, coma, immunosuppression and antibiotics. The source of pathogenic bacteria may be endogenous due to translocation overgrowth of pathogens from normal flora or exogenously transferred from the hospital staff, equipment or environment.

Enteral Tube Feeding

Feeding

Early initiation of enteral feeding is generally regarded as beneficial in critically ill patients, but it may increase the risk of gastric colonization, gastroesophageal reflux, aspiration, and pneumonia.[53,54] Cultures of simultaneously sampled daily gastric, tracheal, and oropharyngeal specimens from 18 mechanical ventilator dependent patients not receiving antacids or H2 antagonists showed that, after enteral feeding was started, the number of gram-negative isolates increased significantly, and five (28%) patients had gram-negative rods that were first recovered in the stomach and subsequently isolated from the trachea.[55] Aspiration at the time of intubation is one of the most

common risk factor causing VAP in ICU patients.The colonization of oropharyngeal tract occurs within the first 48 to 72 hours.[48]

Oropharyngeal aspiration of the colonized secretions overwhelm the defense mechanisms of the body leading to infection and development of pneumonia.[56]

Nasogastric tube allows a direct route from nasopharynx to the upper GI tract. It can also obstruct the drainage of Eustachian tube and paranasal sinuses which further enhance collection of secretions in the oropharynx leading to colonization. Nasogastric tubes, especially of the wide bore type interfere with the functioning of gastroesophageal sphincter, so promoting regurgitation. It provides a conduit where bacteria are transmitted upon its surface in a retrograde fashion from stomach to oropharynx. It might also cause erosion of oropharyngeal mucosa and promote gastric colonisation.

A study was conducted to determine whether gastroesophageal reflux and microaspiration in intubated patients can be reduced by the use of a small-bore nasogastric tube, 17 patients intubated for more than 72 hours were assigned to two different groups to receive in randomized order one of two different types of nasogastric tubes one with a 6.0-mm external bore and the other with a 2.85-mm external bore.[57] (after instillation of radioactive technetium colloid in each patient's stomach,) No differences were found between tube types when the time course and cumulative counts of pharyngeal and tracheal samples were compared, suggesting that small-bore nasogastric tubes do not reduce gastroesophageal reflux or microaspiration in intubated patients.

Gastric Luminal pH and stress ulcers

In critically ill patients it has been seen that 59% of gastric cultures were positive for Gram negative bacteria when the gastric pH was more than 4, where as only 14% of the cultures were positive when pH was less than 4. Increased Gram negative colonization led to an increased infection rate. Increased use of antacids and H2 blockers was also associated with increased rates of VAP.[57]

In another study by Driks et al, Gram negative bacteria were found in the trachea of 58% of those who had received antacids and/or H2 blockers to prevent bleeding and in 30% of those receiving sucralfate for this purpose.[58]

There are data to suggest that use of sucralfate which effectively prevents stress ulcer bleeding without elevating the gastric pH and was found to be associated with lower incidence of VAP. The beneficial effect of sucralfate on pneumonia and mortality rates could have been due to its bactericidal action, its influence on PGE2 production, mucus secretion and mucosal blood flow hence promoting the integrity of whole gut mucosa. It can reduce bacterial translocation across an intact gut wall, which may play a role in pathogenesis of VAP. Sucralfate should be used in cases where stress ulcer prophylaxis is necessary rather than H2 blockers or antacids.[8]

Recumbency

Maintaining mechanically ventilated patients with a nasogastric tube in place in a supine position is also a risk factor for aspiration of gastric contents into the lower airways. It has been shown that recumbency may encourage

retrograde movement of the gastric contents into the esophagus, facilitating oropharyngeal colonisation. Large volume of gastric feeds that overcome limited emptying time of stomach in critically ill patients may further encourage reflux.

In a randomized prospective study conducted by Drakulovic[26] and colleagues, authors found that majority of patients receiving mechanical ventilation were found to have head of bed angles less than 30 degrees, and semi recumbent position to more than 45 degrees significantly reduced the risk of clinically suspected pneumonia by more than 25% than in supine patients.

Transport of the supine patient may not only promote aspiration of gastric contents or contaminated oropharyngeal secretions, but may cause endotracheal condensate to enter the endotracheal tube and so find its way to the lower respiratory tract.

Intubation

Intubation and mechanical ventilation increased the risk of pneumonia by 7 to 21 fold.[27,30,50,51] The endotracheal tube(ET) bypasses the natural upper airway filters and therefore interferes with laryngeal and cough reflex and impedes mucociliary clearance.

Also the pharyngeal flora leaks around the cuff of endotracheal tube and passes into lung predisposing to development of VAP. Contaminated secretions are known to pool just above the endotracheal cuff, an area which is not reached by suctioning devices. These secretions can also go down to the tracheobronchial tree. The risk of development of pneumonia was found to be highest during the

first one to four days of intubation. After this period, the risk associated with these factors decreased. The relationship between the duration of endotracheal intubation and the development of VAP has been examined in several studies.

A prospective study conducted in 23 Italian ICUs that included 724 critically ill patients who had received prolonged (more than 24 hours) ventilatory assistance after admission found a mean rate of VAP to be 23%; the frequency rose from five percent for patients receiving mechanical ventilation for 1 day to 69%[48] for those receiving mechanical ventilation for more than 30 days. Concerning a subset of 124 trauma patients, 67% of whom were ventilated, early-onset pneumonia, defined as pneumonia occurring within the first 96 hours after admission, represented 63% of the 41 pulmonary infections complicating the course of these patients. Fagon et al had estimated an increased risk of pneumonia of one percent per day of mechanical ventilation.[17]

Torres et al estimated an increased incidence of pneumonia among patients ventilated for greater than five days as compared to less than five days.[8] However some studies demonstrated a high and constant rate of VAP in the first 8 to 10 days of endotracheal intubation, with a low rate after that.[32,33,59] These studies showed that endotracheal tube itself increases the risk of pneumonia several fold by providing a direct conduit for bacteria to the tracheobronchial tree, bypassing the defences of upper respiratory tract. They also showed that ET tube interferes with the cough reflex which is an important protective mechanism for the airway.

Certain studies suggested that ventilator circuits should be changed every 48 hours rather than 24 hours.[60,61] This was based on the finding of significantly increased rate of pneumonia in patients assigned 24 hours ventilator circuit change which probably resulted from increased manipulation of patients Endotracheal Tube and inadvertent flushing of contaminated tubing, increasing the leakage of bacteria around the ET into trachea. These studies showed that 80% of ventilator condensates are contaminated by bacteria from the patient's own respiratory tract and the accumulation of pooled condensate provide a place for bacteria to multiply in, safe from host defenses and from the effects of antibiotics.

Studies done by Fagon et al, gave recommendations that intubation and reintubation should be avoided, if possible, as it increases the risk of VAP and noninvasive ventilation should be used whenever possible.[17,61] In addition to the presence of endotracheal tubes, reintubation is, per se, a risk factor for VAP. This finding probably reflects an increased risk of aspiration of colonized oropharyngeal secretions into the lower airways by patients with subglottic dysfunction or impaired consciousness after several days of intubation. Another explanation is direct aspiration of gastric contents into the lower airways, particularly when a nasogastric tube is kept in place after extubation.

According to a case-control study, the pneumonia rate was 47% for reintubated patients compared with 4% for control subjects matched for the duration of prior mechanical ventilation. The role of early tracheostomy in VAP prevention remains controversial, with only a few studies examining this issue. Whereas some studies found a reduction in the rate of VAP in patients with early

tracheostomy, others could not demonstrate any benefit.[62-64] In a randomized, prospective, multicenter trial including 112 patients who were anticipated to need prolonged mechanical ventilation, there were no differences, at least until day 14, between ICU length of stay, pneumonia rate, or mortality between the 53 patients who underwent early (Day 3 to 5) tracheostomy and the 59 who were managed by translaryngeal intubation.[65] The investigators of the trial postulated that presence of tracheostomy tube may produce reflex mucus secretion which provide mucus receptors for bacterial adherence and serve as a bridge between bacteria and respiratory epithelium.

Diabetes Mellitus

Diabetes mellitus is considered another major risk factor for the development of VAP. It causes immunocompromised state in patients making them more susceptible to infections like pneumonia.[53]

Surgery

A study by Cunnion KM et al comparing adult ICU populations demonstrated that postoperative patients had consistently higher rates of nosocomial pneumonia than did medical ICU patients, with a relative risk of 2.2.[53] It has been suggested that different surgical ICU patient populations may have different risks for nosocomial pneumonia: cardiothoracic surgery and trauma (particularly head injury) patients were more likely to develop VAP than medical or other types of surgical patients. In another study conducted by Celis R, et al postsurgical patients are at high risk for VAP, which accounts for nearly one-third of the pulmonary infiltrates in these ICU patients.[52]

A history of smoking, longer preoperative stays, longer surgical procedures, and thoracic or upper abdominal surgery were also significant risk factors for postsurgical pneumonia.[54]

Two Indian studies have identified emergency operations as independent risk factors as patients who undergo emergency surgeries are often haemodynamically unstable and require longer ventilatory support.[63,64]

After certain cardiac surgeries, immunosupression caused by extracorporeal circulation, anaesthetics, transfusion of blood products, body position and mechanical ventilation favour the development of pulmonary infection.

Drugs

Many drugs are known to have adverse effects on the immune system. These include antibacterial agents, steroids, cancer chemotherapeutics and other cytotoxic agents. Cytotoxic agents along with steroids affect immune system of the patient and make them more susceptible to infections. Steroids have an additional affect of causing a state of hyperglycemia leading to delayed recovery from infections.

Betalactam antibiotics in the hospital setting have been associated with an increased risk of nosocomial pneumonia and selection of resistant pathogens. This has been reported in a lot of studies across various countries. In a cohort study of 320 patients by Kollef MH et al, prior antibiotic administration like first

generation cephalosporins was identified by logistic regression analysis to be one of the variables independently associated with VAP.[56]

The use of succinylcholine for pharmacological paralysis has been associated with contraction of gastric smooth muscle, causing vomiting and aspiration. Use of sedation is an integral part of ICU management for patients put on ventilator. Sedating agents have been shown to cause impaired cough reflex and aspiration of oropharyngeal contents leading to VAP.

Other local infections

In a study of 300 patients who required mechanical ventilation for at least 7 days and were randomly assigned to undergo nasotracheal or orotracheal intubation, computed tomographic evidence of sinusitis was observed slightly more frequently in nasotracheal group than in oral endotracheal group, but this difference disappeared when only bacteriologically confirmed sinusitis was considered.[66]

Orally intubated patients have been found to have evidence of sinusitis, by culture of maxillary sinus secretions. The absence of normal airflow in an intubated patient and also absence of sneezing and cough reflex, may make the patient more susceptible to infection.

Microorganisms

Microorganisms responsible for VAP may differ according to the population of patients in the ICU, the durations of hospital and ICU stays, and the specific diagnostic methods used. The high rate of respiratory infections due to

Gram negative bacteria in this setting has been repeatedly documented.[43,50,54] The data from 24 investigations conducted with ventilated patients, for whom bacteriologic studies were restricted to uncontaminated specimens, confirmed those results: Gram negative bacteria represented 58% of recovered organisms.[61]

Several studies have reported that more than 60% of VAP is caused by aerobic Gram negative bacteria.[31,43,49,57]

More recently, however, some investigators have reported that gram-positive bacteria have become increasingly more common in this setting, with S.aureus being the predominant gram-positive isolate.[17] The European prevalence of infection in Intensive care (EPIC) study and the National Nosocomial Infections Surveillance (NNIS) had found a high prevalence of Methicillin Resistant Staphylococcus Aureus (MRSA) and Pseudomonas species as pathogens causing VAP.[67,68] Staphylococcus aureus was responsible for most episodes of nosocomial pneumonia in the EPIC Study, accounting for 31% of the 836 cases with identified responsible pathogens.[67]

The predominant Gram negative bacteria were P.aeruginosa and Acinetobacter spp., followed by Proteus spp., Escherichia Coli, Klebsiella spp., and H. influenza. A relatively high rate of gram-positive pneumonias was also reported in those studies, with Staphylococcal aureus involved in 20% of the cases.

High rates of polymicrobial infection in VAP have been observed in various studies.[65,69-71] In a study of 172 episodes of bacteremic nosocomial pneumonia, 13% of lung infections were caused by multiple pathogens.

Similarly, when the protective bronchial specimen technique was used to identify the causative agents in 52 consecutive cases of VAP, a 40% polymicrobial infection rate was found, a value similar to that observed in another study conducted at the same time on a comparable population of ventilated patients.[72]

Underlying diseases may predispose patients to infection with specific organisms. Patients with chronic obstructive pulmonary disease (COPD) are, for example, at increased risk for H.Influenzae, Moraxella catarrhalis or S.pneumoniae infections; whereas trauma and neurologic patients are at increased risk for S.aureus infection.[39,63,73]

Organisms responsible for early onset ventilator associated pneumonia (VAP) were common respiratory pathogens or normal pharyngeal flora,possibly introduced at the time of intubation,or shortly after ICU admission. The microbiologic etiology of late onset VAP included aerobic Gram negative bacilli and Staphylococcus aureus.[56] The etiology was also influenced by two other factors**:** prior antibiotic therapy and the duration of mechanical ventilation. Pseudomonas aeruginosa was the most likely infective agent in patients who had received prior antibiotic therapy. In the NNIS study half of the cases of VAP were associated with enteric Gram negative bacteria specially P. aeruginosa (17.2%), enterobacter species (10.4%) and Klebsiella pneumonia (19%).[68]

Acinetobacter and P. aeruginosa were most important in causing VAP and caused significant morbidity and mortality.

Legionella species, anaerobes, fungi and viruses are mentioned as potential causative agents but not considered to be common in the context of

pneumonia acquired during mechanical ventilation. However, several of these causative agents may be more common than previously thought and potentially underreported because of difficulties involved with the diagnostic techniques used to identify them, including anaerobic bacteria and viruses. In a study conducted to determine the frequency of anaerobes in 130 patients with a first episode of bacteriologically documented VAP, with special precautions taken to preserve anaerobic conditions during PSB transport and microbiologic procedures, anaerobes were involved in 23% of the total number of episodes and the main strains isolated were as follows: Prevotella melaninogenica (36%), Fusobacterium nucleatum (17%), and Veilionella parvula (12%).[60]

The probability of recovering anaerobic bacteria was particularly high in orotracheally intubated patients and patients in whom pneumonia occurred during the five days after ICU admission. In another study conducted over a five year period, cytomegalovirus (CMV) was identified as a possible cause of VAP in 25 of 86 patients.[62]

Diagnosis

The establishment of an appropriate diagnosis of VAP is one of the most crucial and difficult issues in critically ill patients. Both invasive and non invasive methods have been used for diagnosis. Qualitative cultures of endotracheal tubes or aspiration materials have led to over diagnosis of VAP when compared to quantitative sampling by invasive methods, including Protected bronchial specimens (PSB) or Bronchoalveolar lavage (BAL).

Pugin et al. proposed to combine the seven variables- temperature, leukocytosis, tracheal aspirate volume and purulence of tracheal secretions, chest X-ray, oxygenation- PaO2/FiO2 ratio- and semiquantitative culture of tracheal aspirate for the diagnosis of VAP, defined as clinical pulmonary infection score (CPIS). The score varied from 0 to 12 points, and a CPIS of more than six was associated with a sensitivity of 93% and a specificity of 100% for the diagnosis of pneumonia.[61] In a post mortem study, Papazian and colleagues reported a high diagnostic accuracy of CPIS at a threshold of 6 (72% sensitivity and 85% specificity).[62]

Flanagon et al[74] compared the CPIS to non bronchoscopic lung lavage data in a population of 145 patients. The CPIS for all 34 patients with VAP was significantly higher than the score of non pneumonia patients (7.6 Vs 4.1; $p<0.0001$) and using a score of seven to diagnose pneumonia, the sensitivity was 85%, the specificity 91%, the positive predictive value 61% and negative predictive value 96%.

The spread of microorganism to blood or pleural space is less than 10%, so blood and pleural effusion cultures have low sensitivity and specificity. Luna and colleagues demonstrated that the positive predictive value of blood cultures to detect the etiologic microorganism was 73% and the sensitivity of blood cultures was only 26%.[63]

Tracheal Aspirate

Culture of Endotracheal aspirate (ETA), even in combination with Gram stain was not able to distinguish colonization from pneumonia. However there are

several studies which have examined the utility of ETA specimens in patients with VAP.[37,75] Marquette et al in their study demonstrated that a value of 10^6 colony forming unit(cfu)/ml was the most accurate diagnostic threshold.[76]

Protected Specimen Brush Technique (PSB)

To avoid contamination from upper airways, a double lumen system with telescoping cannulas and a distal carbovax plug introduced through the inner channel of fibreoptic bronchoscope is advanced under direct vision into the bronchial orifice of a lung segment containing an infiltrate on chest radiograph. A quantitative culture of 10^3 cfu/ml was accepted as the diagnostic threshold for lower respiratory tract infections using the PSB. The sensitivity of PSB was found to be 60% with a specificity of 96%.[77]

Bronchoalveolar Lavage

In this technique the bronchoscope is wedged under vision into the bronchus according to the chest radiographic appearance. Lavage is carried out using 120 ml of sterile isotonic saline in several aliquots. A 10^4 cfu/ml was an interpretative threshold for quantitative culture results.[75]

Recommended measures for prevention of VAP

General measures

- Alcohol based hand disinfection.[78]
- Use of microbiologic surveillance.
- Monitoring and early removal of invasive devices.
- Programmes to reduce antimicrobial prescriptions.[78]

Generally recommended specific measures

- Avoidance of endotracheal intubation
- Avoidance of reintubation
- Preference of noninvasive ventilation (NIV)
- Preference of orotracheal intubation and orogastric tubes[79]
- Maintenance of the ET cuff pressure at approximately 20 cm H_2O[80]
- Avoidance of flushing the condensate into the lower airway or to in-line medication nebulizers[81]
- Patient positioning (semi recumbent position)[82]

Additional measures which might be helpful in distinct settings and populations

- Continuous aspiration of subglottic secretions[82]
- Endotracheal tubes coated with antiseptics or silver[83]
- Preference of heat-moisture exchangers (HMEs) over heater humidifiers (HH)[84]
- Oral decontamination
- Selective decontamination of the digestive tract (SDD)[85]

Initial empiric antibiotic therapy for hospital-acquired pneumonia or ventilator-associated pneumonia in patients with no known risk factors for multidrug-resistant pathogens, early onset, and any disease severity

Potential Pathogen	Recommended Antibiotic
Streptococcus pneumoniae *Haemophilus influenzae* Methicillin-sensitive *Staphylococcus aureus* Antibiotic-sensitive enteric gram-negative bacilli *Escherichia coli* *Klebsiella pneumoniae* *Enterobacter species* *Proteus species* *Serratia marcescens*	*Ceftriaxone* *or* *Levofloxacin, moxifloxacin, Ciprofloxacin* *or* *Ampicillin / Sulbactam* *or* *Ertapenem*

Initial empiric therapy for hospital acquired pneumonia, ventilator-associated pneumonia, and healthcare associated pneumonia in patients with late-onset disease or risk factors for multidrug-resistant pathogens and all disease severity

Potential Pathogens	Combination Antibiotic Therapy*
Pathogens listed above and MDR pathogens *Pseudomonas aeruginosa or* *Klebsiella pneumoniae (ESBL)†* *Acinetobacter species*	Antipseudomonal cephalosporin (cefepime, ceftazidime) or Antipseudomonal carbepenem (imipenem or meropenem) *or* -Lactam/-lactamase inhibitor (piperacillin–tazobactam) *plus* Antipseudomonal fluoroquinolone† (ciprofloxacin or levofloxacin) *or* Aminoglycoside (amikacin, gentamicin, or tobramycin) plus
Methicillin-resistant *Staphylococcus aureus (MRSA)* *Legionella pneumophila†*	*Linezolid or vancomycin‡*

† If an ESBL_ strain, such as *K. pneumoniae*, or an *Acinetobacter* species is suspected, a carbepenem is a reliable choice.

If *L. pneumophila* is suspected, the combination antibiotic regimen should include a macrolide (e.g., azithromycin) or a fluoroquinolone (e.g., ciprofloxacin or levofloxacin) should be used rather than an aminoglycoside.

‡ If MRSA risk factors are present or there is a high incidence locally.

Initial intravenous, adult doses of antibiotics for empiric therapy of hospitalacquired pneumonia, including ventilatorassociated pneumonia, and healthcare-associated pneumonia in patients with late-onset disease or risk factors for multidrug-resistant pathogens

Antibiotic	Dosage
Antipseudomonal cephalosporin	
Cefepime	1–2 g every 8–12 h
Ceftazidime	2 g every 8 h
Carbepenems	
Imipenem	500 mg every 6 h or 1 g every 8 h
Meropenem	1 g every 8 h
β-Lactam/β-lactamase inhibitor	
Piperacillin–tazobactam	4.5 g every 6 h
Aminoglycosides	
Gentamicin	7 mg/kg per d
Tobramycin	7 mg/kg per d
Amikacin	20 mg/kg per d
Antipseudomonal quinolones	
Levofloxacin	750 mg every d
Ciprofloxacin	400 mg every 8 h
Vancomycin	15 mg/kg every 12 h
Linezolid	600 mg every 12 h

Chapter 4

Methodology

METHODOLOGY

The present study was conducted in the Department of Medicine, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum on patients with VAP during the period of January 2010 to December 2010.

Study design

The study design was one year cross sectional study.

Study period and duration

The present one year study was conducted during the period of January 2010 to December 2010.

Method of collection of data

Source of Data

This study was conducted on patients admitted with VAP in Medical Intensive Care Unit (MICU) at KLES Dr Prabhakar Kore Hospital and Medical Researcgh Centre, Belgaum. The MICU is equipped with a split level air conditioning system having nurse patient ratio of 1:3 for ventilated patients. It has facilities for conventional ventilatory support and rigorous monitoring of all critically ill patients.

Sample size and sampling method

A total of 53 patients who developed VAP during the study period at MICU, KLES Dr Prabhakar Kore Hospital and Medical Research Centre, Belgaum were included in the study.

Selection criteria

Inclusion Criteria

- All MICU patients above the age of 18 years of either gender who were receiving mechanical ventilation and went on to develop VAP were included in the study.

Exclusion Criteria

- All patients with signs and symptoms of pneumonia, along with radiological findings prior to intubation were excluded.

Ventilatory associated pneumonia

The diagnosis of VAP was made according to clinical and laboratory finding. Investigations comprising complete blood count, biochemical tests including blood sugar, creatinine, liver function tests, Chest X Ray Sputum Grams stain and culture, blood and pleural fluid culture were listed and analysed.

Using this simple system, investigators have found a good co-relation between diagnosis based on BAL and CPIS results. VAP was defined by CPIS greater or equal to seven during course of intubation.[86,87]

Appendix for CPI [Clinical pulmonary infection score][86,87]

1. Temperature (Centigrade)

- ≥ 36.5 and ≤ 38.4 (0 pt.)
- ≥ 38.5 and ≤ 38.9 (1 pt.)
- ≥ 39 or ≤ 36 (2 pt.)

2. White blood cell count (/mm^3)

- ≥ 4K and ≤ 11k (0 pt.)
- ≤ 4k or > 11k (1 pt.)
- Plus band forms (1 pt.)

3. Tracheal secretions

- Absence of tracheal secretions (0 pt.)
- Presence of non purulent tracheal secretions (1 pt.)
- Presence of purulent tracheal secretions [2 pt]

4.P_aO_2/F_1O_2 (mm hg)

- > 240 or ARDS (0 pt.)
- 200 to 240 and no ARDS (2 pt.)

5. Chest x-rays

- No infiltrate (0 pt.)
- Diffuse / patchy infiltrate (1 pt.)
- Focal infiltrate (2 pt.)

6. Endotracheal aspirate culture (0-3+ growth)

- No growth or <=1+ pathogens (0 pt.)
- 1+ of a pathogen or more (1 pt.)
- Plus same pathogen on gram stain (1 pt.)

Procedure

The study was approved by the Institutional Ethics Committee of Jawaharlal Nehru Medical College, Belgaum. Patients Admitted in MICU under the Department of Medicine at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum were evaluated based on selection criteria for VAP diagnosis based on CPIS results. The selected patients were briefed about the nature of the study and a written informed consent was obtained (Annexure–I).

Demographic data like gender and age were collected along with relevant history and recorded on predesigned and pretested proforma (Annexure-II). A thorough clinical examination was conducted and the findings were also recorded.

All relevant data from patient's medical records, bed side flow sheets including gender, age, admission diagnosis were noted. History of preexisting diseases like Diabetes Mellitus, Hypertension, Stroke, Ischaemic Heart Disease, and previous admission to hospital and present symptomatology was listed and detailed physical examination was done. Details of medical interventions were recorded.

ET aspirate

On making a diagnosis of ventilator associated pneumonia, ETA was obtained for microbiological Quantitative assay. After hand washing with soap and water for two minutes and wearing sterile gloves, the intracath was introduced through the ET and advanced beyond the carina, to collect the lower respiratory tract seretions into a mucus extracter. A quantitative count of geater than 10^5 cfu/ml was labeled as infection. Colonisation was defined as isolation of microorganism where CFU was $<10^5$ cfu/ml.

Pneumonia was called progressive when clinical and radiological picture worsened, along with isolation of microorganism with a quantitative count of more than 10^5 cfu/ml of ETA .The sensitivity pattern was studied by 'Kirby-Bauer's disk diffusion method'.

Risk Factors for VAP such as number of intubations and duration of intubation, duration of mechanical ventilation, tracheostomy, use of nasogastric tube feeding, use of sedative drugs, steroids co morbid conditions like DM, sepsis were studied.

Statistical analysis

The data obtained was tabulated on Excel spread sheet (Annexure IV). The data was expressed as rates, ratios and percentages. The continuous variables were expressed as mean and standard deviation (SD). The data was analysed using chi-square test. A probability value (p value) of less than or equal to 0.05 was considered as statistically significant.

Chapter 5

Results

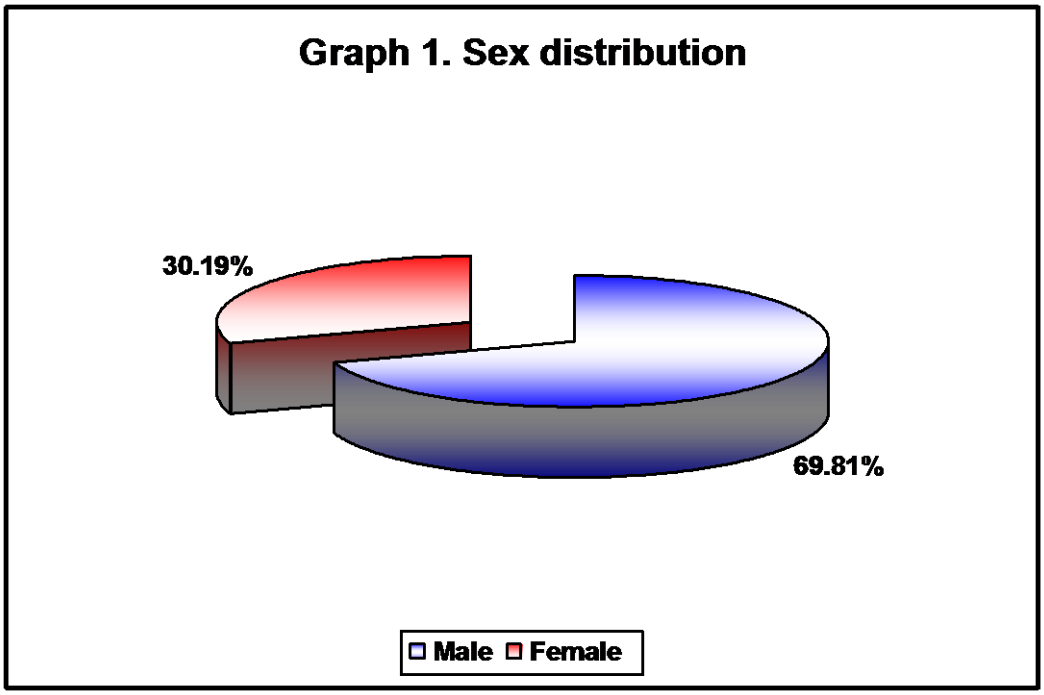
RESULTS

The present one year cross sectional study was conducted in the Department of Medicine, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum on 53 patients with VAP during the period of January 2010 to December 2010. The diagnosis of VAP was made according to clinical and laboratory finding.

The data obtained was tabulated and expressed as rates, ratios and percentages. The continuous variables were expressed as mean and standard deviation (SD) and analyzed as below.

Table 1. Sex distribution

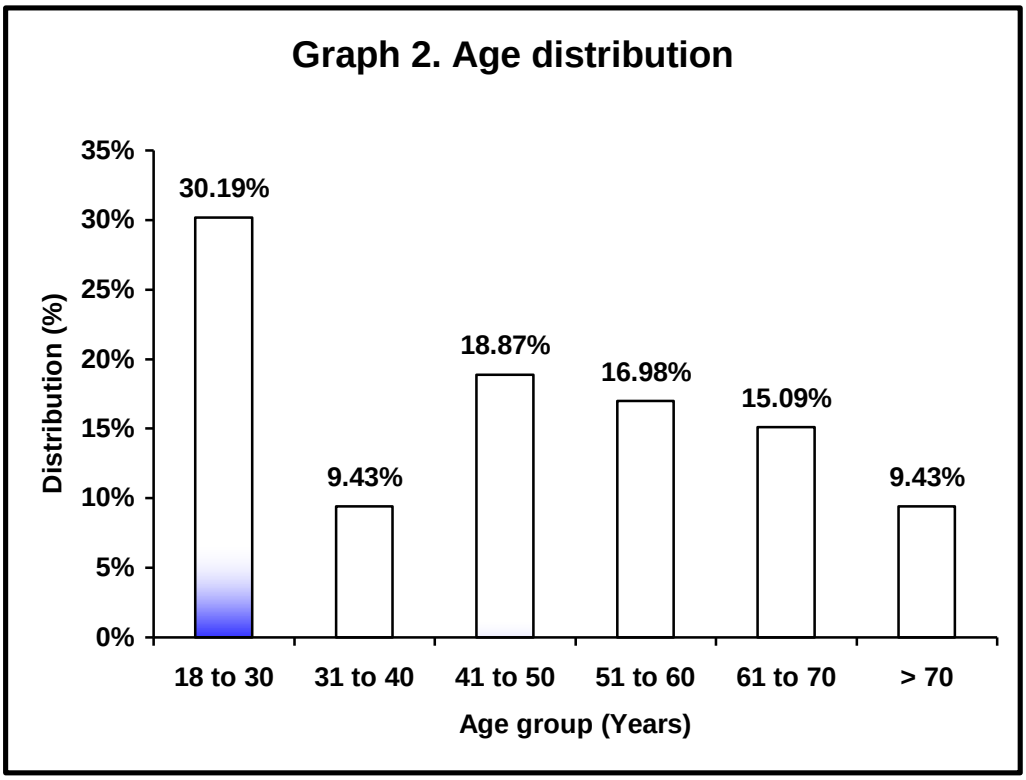
Sex	Distribution (n=53)	
	Number	**Percentage**
Male	37	69.81
Female	16	30.19
Total	**53**	**100.00**



Of these 53 patients with VAP, 37 were males (69.81%) and 16 were females (30.19%).

Table 2. Age distribution

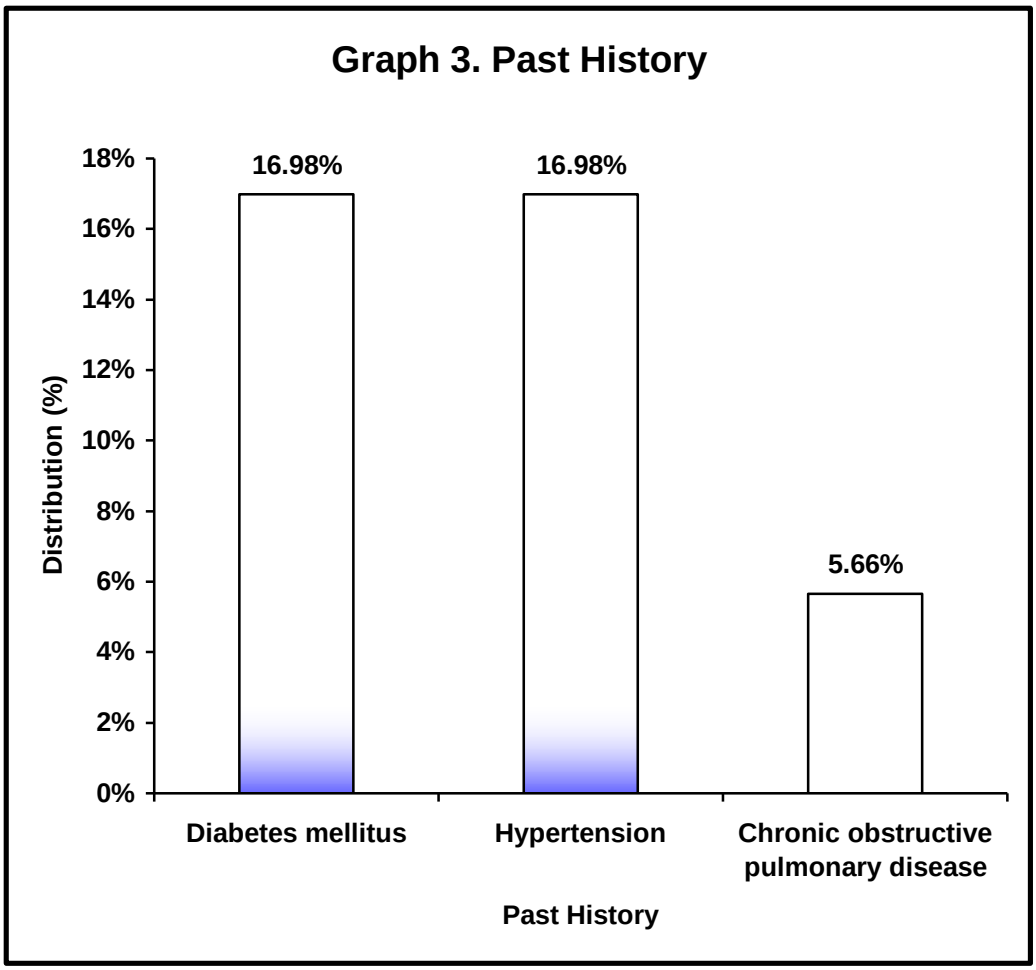
Age group (Years)	Distribution (n=53)	
	Number	**Percentage**
18 to 30	16	30.19
31 to 40	5	9.43
41 to 50	10	18.87
51 to 60	9	16.98
61 to 70	8	15.09
> 70	5	9.43
Total	**53**	**100.00**



Bimodal distribution of age was observed.

Table 3. Past History

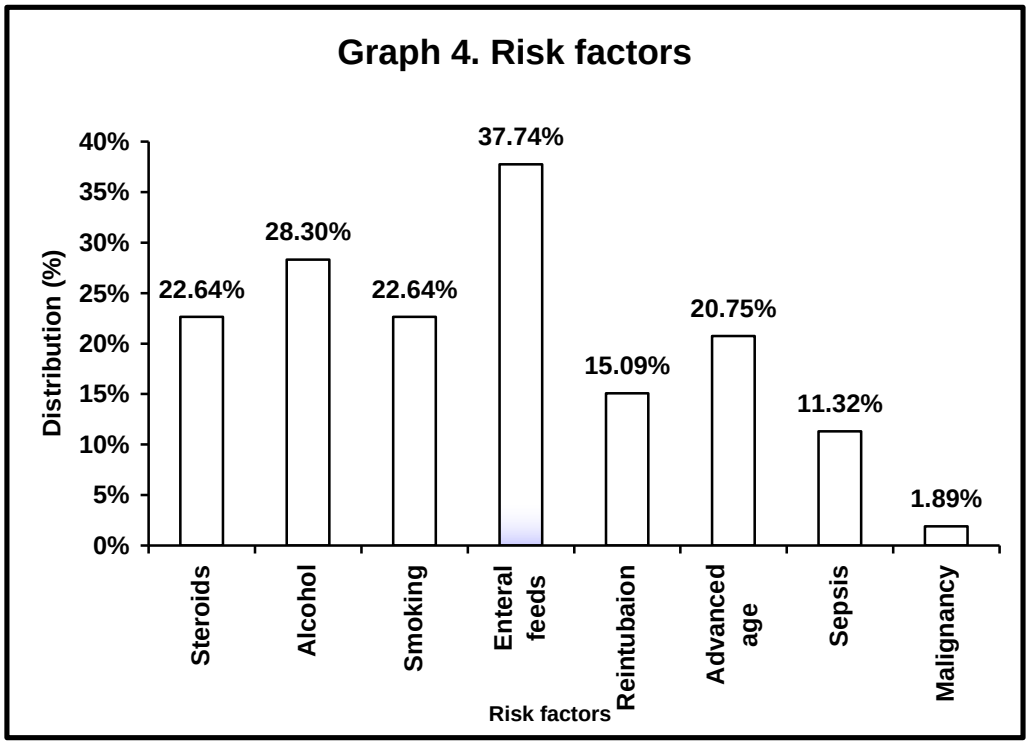
Past history	Distribution (n=53)	
	No.	**Percentage**
Diabetes mellitus	9	16.98
Hypertension	9	16.98
Chronic obstructive pulmonary disease	3	5.66



Out of 53, nine (16.98%) had history of DM and HTN.

Table 4. Risk factors

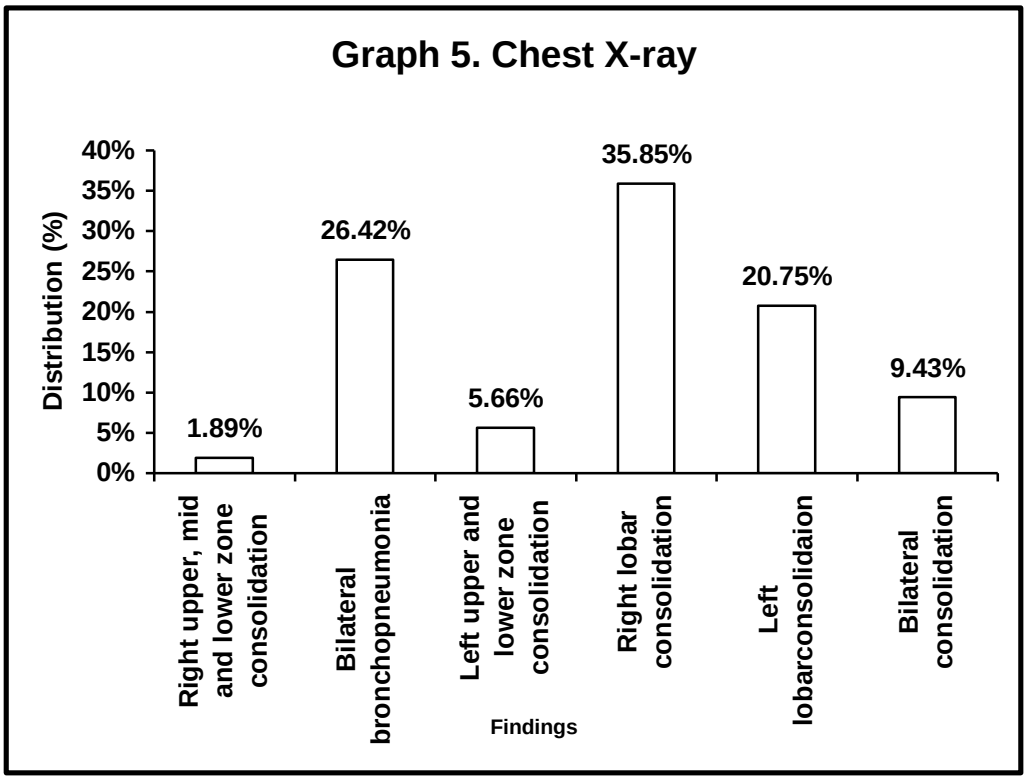
Risk factors	Distribution (n=53)	
	Number	**Percentage**
Steroids	12	22.64
Alcohol	15	28.30
Smoking	12	22.64
Enteral feeds	20	37.74
Reintubation	8	15.09
Advanced age	11	20.75
Sepsis	6	11.32
Malignancy	1	1.89



Among the risk factors, 37.74% patients had enteral feeds followed by 28.3% had history of alcohol consumption.

Table 5. Chest X-ray

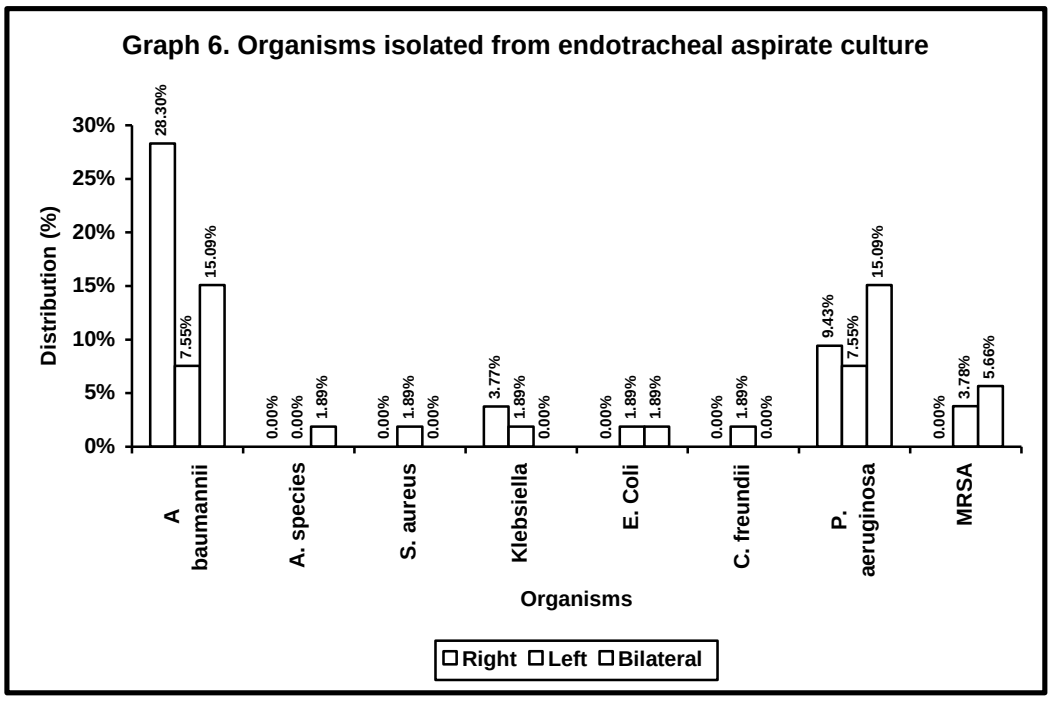
Findings	Distribution (n=53)	
	Number	**Percentage**
Right upper,mid and lower zone consolidation	1	1.89
Bilateral bronchopneumonia	14	26.42
Left upper and lower zone consolidation	3	5.66
Right lobar consolidation	19	35.85
Left lobar consolidation	11	20.75
Bilateral consolidation	5	9.43
Total	**53**	**100.00**



Of the 53 patients, 19 (35.85%) developed bilateral pneumonia and 20 (37.74%) developed right sided pneumonia.

Table 6. Organisms isolated from endotracheal aspirate culture

Organism	Right (n=22)		Left (n=12)		Bilateral (n=19)		Total (n=53)	
	No.	%	No.	%	No.	%	No.	%
A. baumannii	15	28.30	4	7.55	8	15.09	27	50.94
A. species	0	0.00	0	0.00	1	1.89	1	1.89
S. aureus	0	0.00	1	1.89	0	0.00	1	1.89
klebsiella	2	3.77	1	1.89	0	0.00	3	5.66
E. Coli	0	0.00	1	1.89	1	1.89	2	3.77
C. freundii	0	0.00	1	1.89	0	0.00	1	1.89
P. aeruginosa	5	9.43	4	7.55	8	15.09	17	32.08
MRSA	0	0.00	1	1.89	2	3.78	3	5.66
Total	**22**	**41.51**	**13**	**24.53**	**20**	**37.74**	**55**	**103.77**



A. baumannii and P. aeruginosa were the most common organisms causing bilateral pneumonia. Of the organisms isolated A. baumannii was isolated in 27 patients and P. aeruginosa was isolated in 17 pts which amounts to 50.94% and 32.08 %respectively.

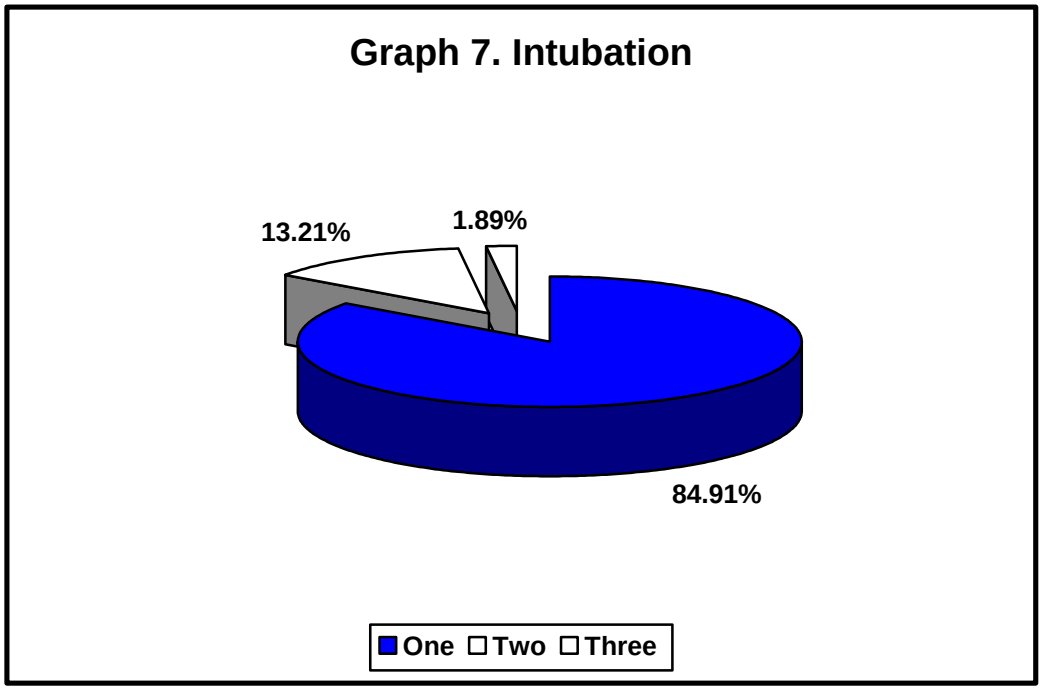
Table 7. Diagnosis

Diagnosis	Distribution (n=53)	
	Number	**Percentage**
malaria	4	7.55
GB syndrome	3	5.66
Dengue fever	3	5.66
Op poisoning	6	11.32
Hanging	2	3.77
Stroke	5	9.43
COPD	3	5.66
Snake bite	1	1.89
Postpartum sepsis	2	3.77
Epilepsy	1	1.89
Malignancy	1	1.89
Alcoholic liver disease	3	5.66
Myasthenia gravis	1	1.89
Acute pancreatitis with ARF	1	1.89
Acute lung injury(fumes)	1	1.89
UTI with urosepsis	2	3.77
Metabolic encephalopathy	2	3.77
Congestive cardiac failure	4	7.55
Rt lower limb cellulitis	1	1.89
ARF	1	1.89
Viral fever with encephalitis	2	3.77
Hepatic encephalopathy	2	3.77
Postpartum CVT	1	1.89
Thymoma	1	1.89
Total	**53**	**100.00**

Of the 53 patients studies, 11.32% were organophosphorous poisoning and 9.43% had stroke. The other diagnosed are as shown in table.

Table 8. Intubation

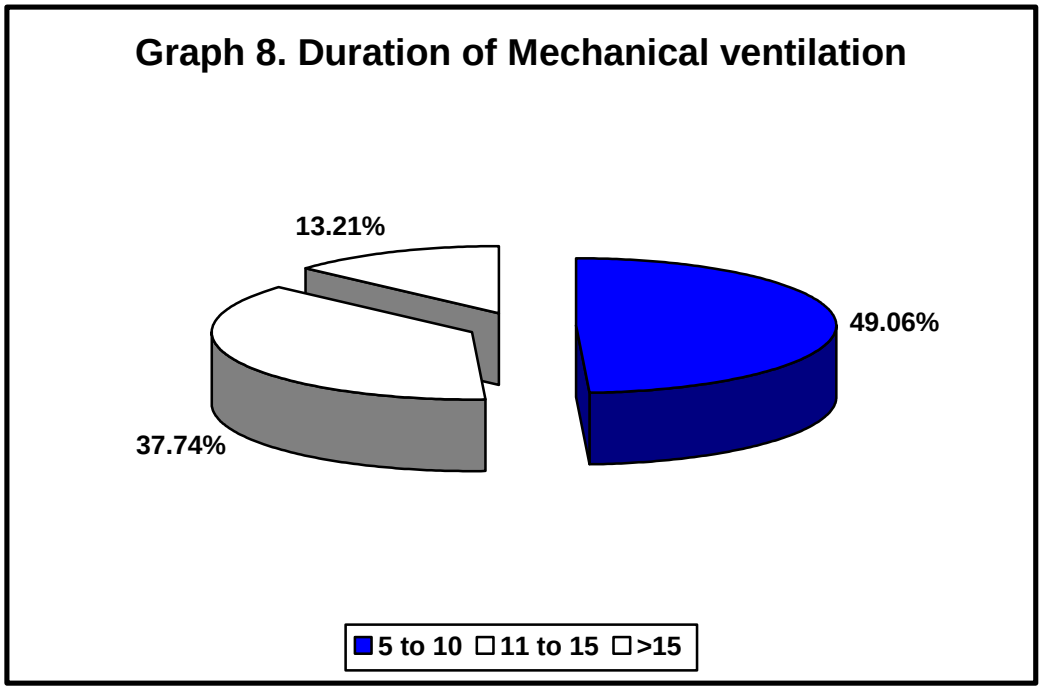
Number of times	Distribution (n=53)	
	No.	**Percentage**
One	45	84.91
Two	7	13.21
Three	1	1.89
Total	**53**	**100.00**



Out of the 53 patients 8 of them were reintubated of which 7 were intubated twice and 1 patient was intubated thrice

Table 9. Duration of Mechanical ventilation

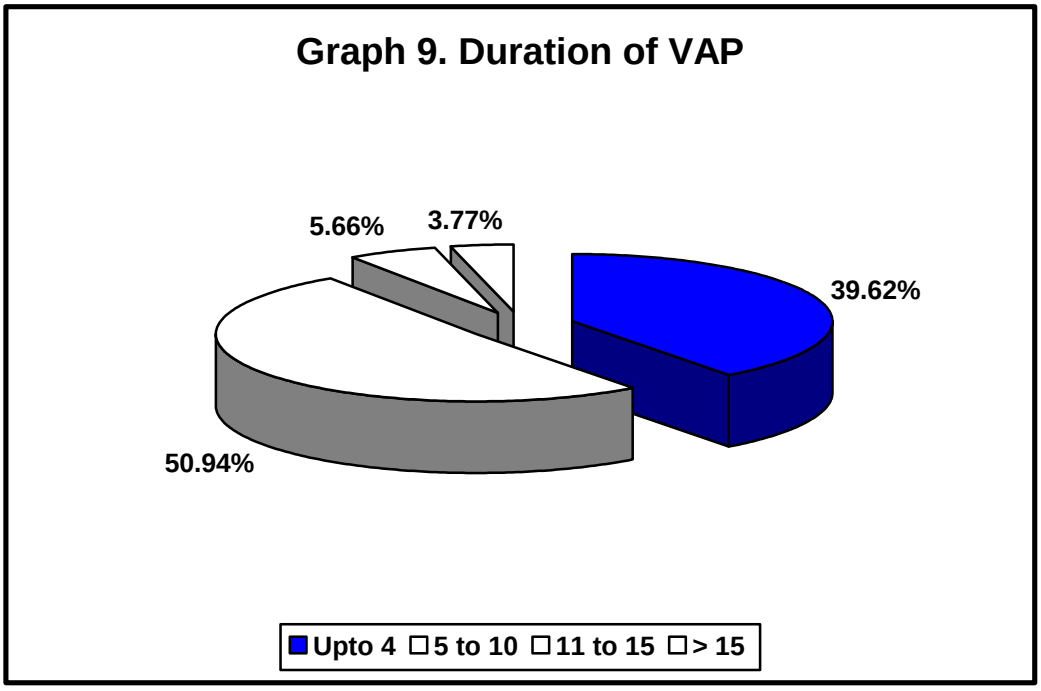
Duration (Days)	Distribution (n=53)	
	No.	**Percentage**
5 to 10	26	49.06
11 to 15	20	37.74
> 15	7	13.21
Total	**53**	**100.00**



Out of the 53 patients 49.06% were on mechanical ventilation for 5 to10 days, 37.74% were on ventilator for 11 to 15 days.

Table 10. Duration of VAP

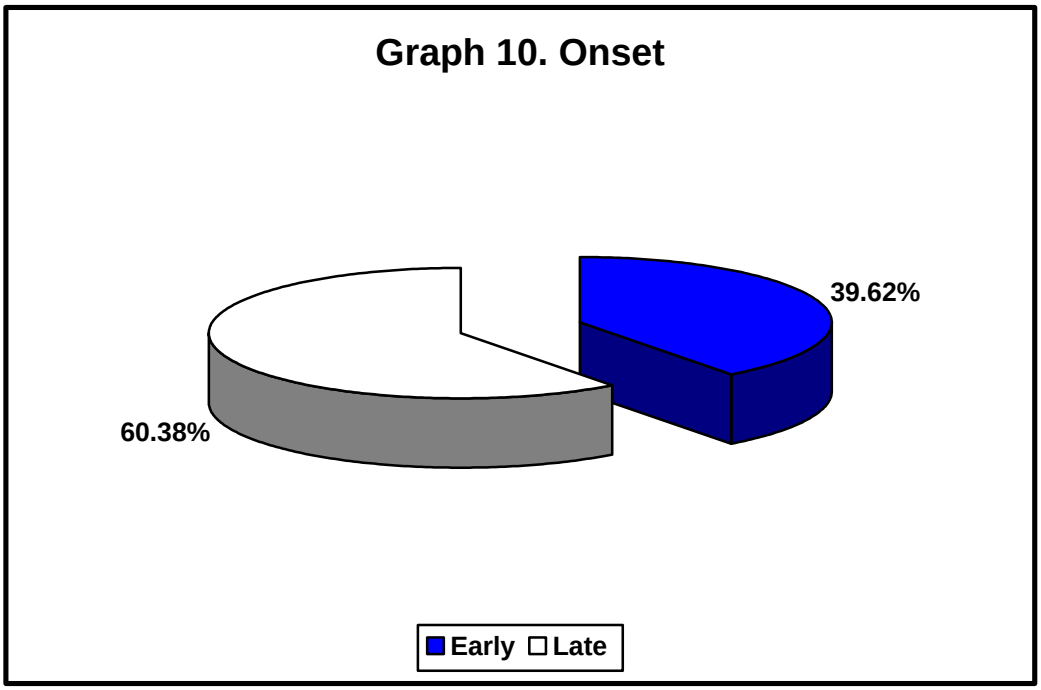
Duration (Days)	Distribution (n=53)	
	No.	**Percentage**
upto 4	21	39.62
5 to 10	27	50.94
11 to 15	3	5.66
> 15	2	3.77
Total	**53**	**100.00**



More than half (50.94%) of the patients developed VAP between five to ten days.

Table 11. Onset

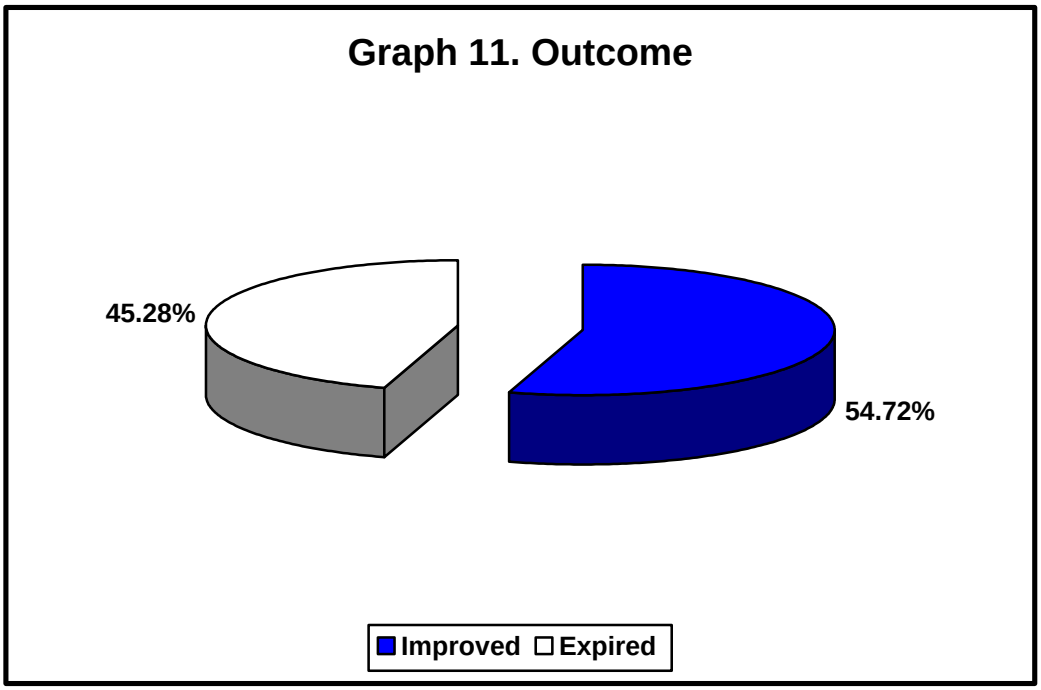
Onset	Distribution (n=53)	
	No.	**Percentage**
Early	21	39.62
Late	32	60.38
Total	**53**	**100.00**



Early onset VAP was seen in 21 patients and late onset vap was seen in 32, that is 39.62 %and 60.38% respectively. Out of the 32 patients who developed late VAP, 27 of them developed VAP between 5 to 10 days.

Table 12. Outcome

Outcome	Distribution (n=53)	
	No.	**Percentage**
Improved	29	54.72
Expired	24	45.28
Total	**53**	**100.00**

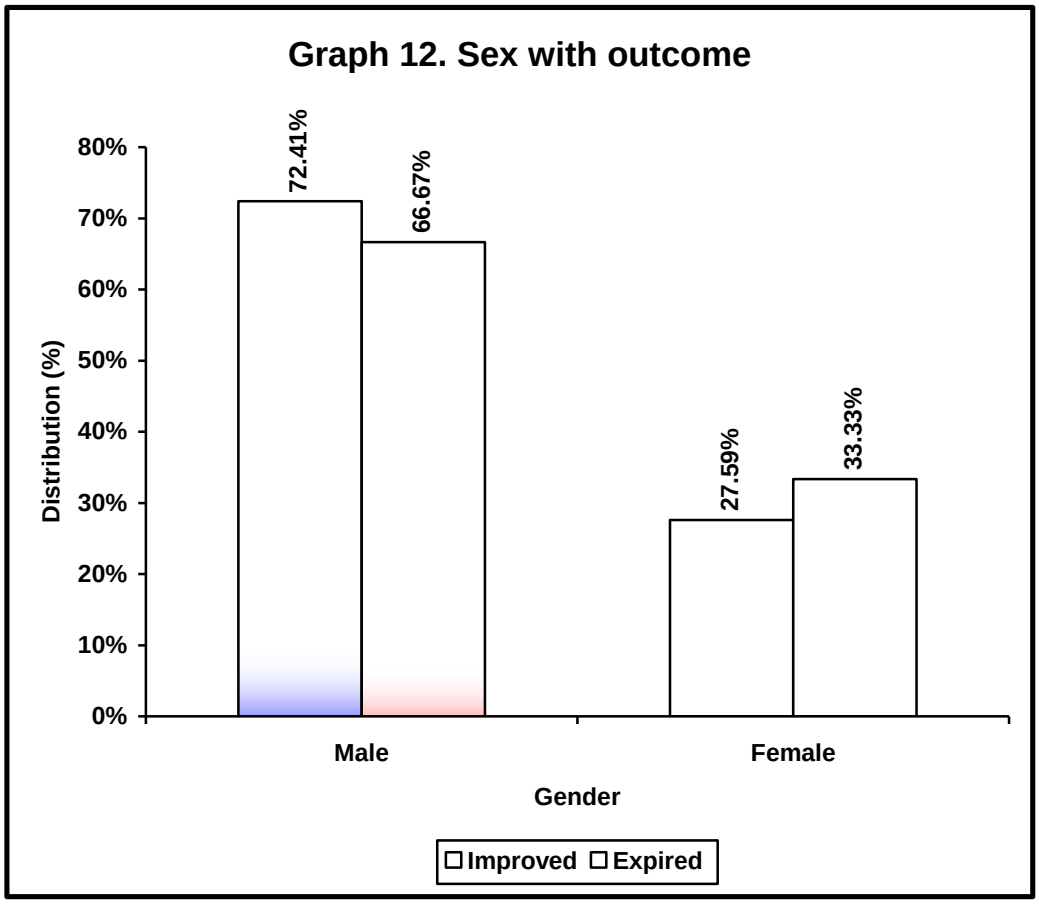


Of the 53 patients, 24 (45.28%) expired and 29 (54.72) of them recovered.

Table 13. Sex with outcome

Gender	Improved (n=29)		Expired (n=24)	
	No.	**Percentage**	**No.**	**Percentage**
Male	21	72.41	16	66.67
Female	8	27.59	8	33.33
Total	**29**	**100.00**	**24**	**100.00**

x^2=0.206 DF=1 p=0.650

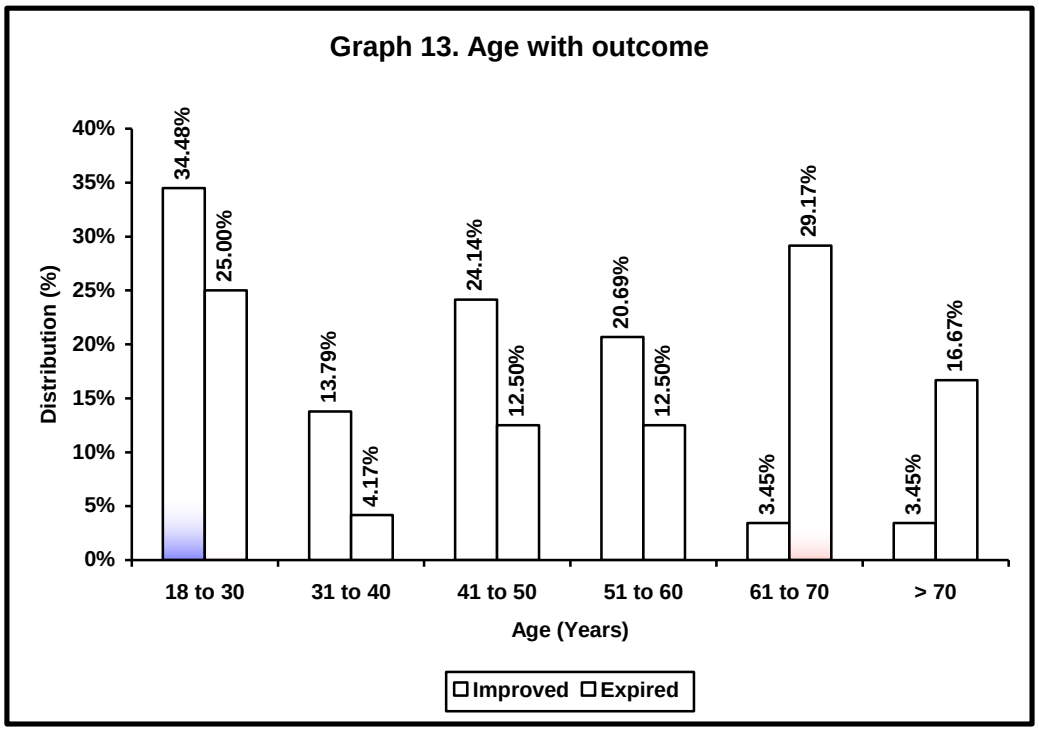


Out of the 37 males 16 of them expired, and 8 out of 16 females expired suggesting sex did not influence the outcome of patients with VAP (p>0.05).

Table 14. Age with outcome

Age (Years)	Improved (n=29)		Expired (n=24)	
	No.	Percentage	No.	Percentage
18 to 30	10	34.48	6	25.00
31 to 40	4	13.79	1	4.17
41 to 50	7	24.14	3	12.50
51 to 60	6	20.69	3	12.50
61 to 70	1	3.45	7	29.17
> 70	1	3.45	4	16.67
Total	**29**	**100.00**	**24**	**100.00**

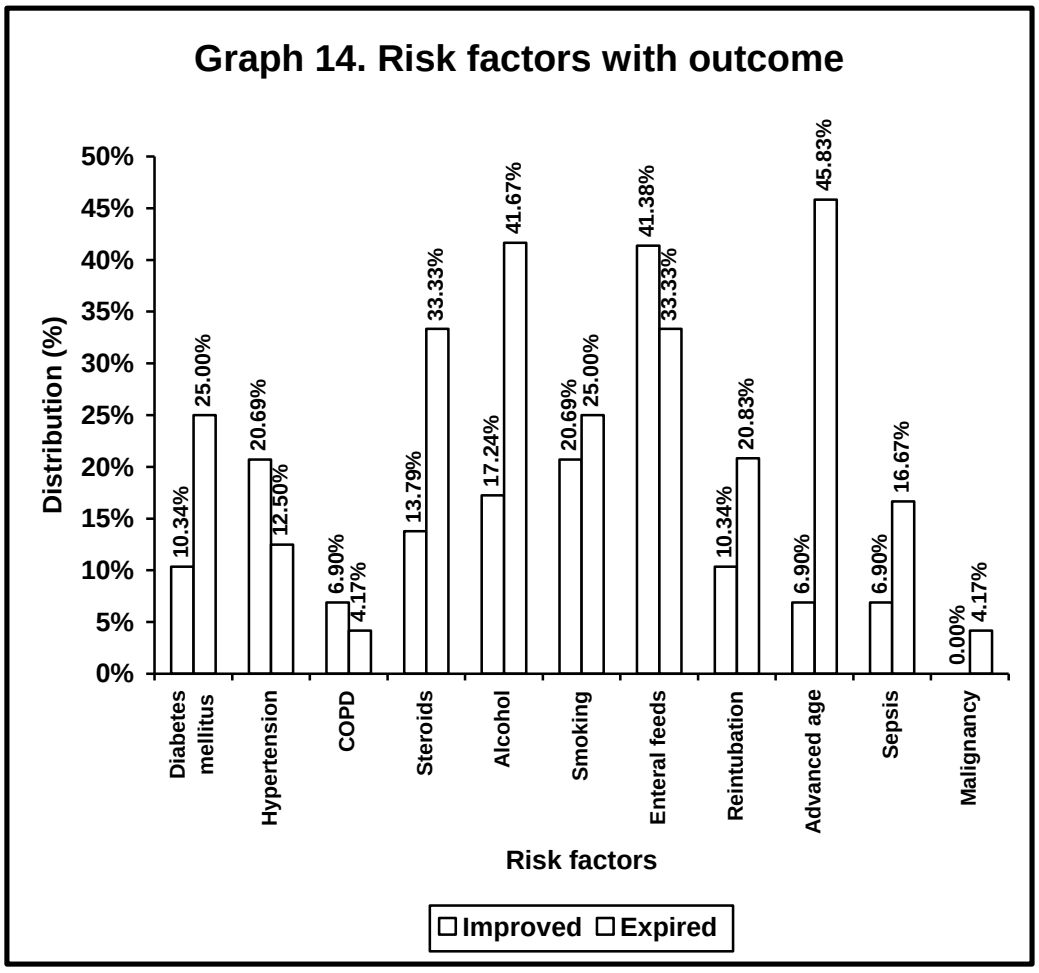
x^2=14.576 DF=1 p<0.001



Out of the 24 patients expired 11 were greater than 60 years of age suggesting advanced age as a significantly associated risk factor in patients with VAP (p<0.001).

Table 15. Risk factors with outcome

Risk factors	Improved (n=29)		Expired (n=24)	
	No.	**Percentage**	**No.**	**Percentage**
Diabetes mellitus	3	10.34	6	25.00
Hypertension	6	20.69	3	12.50
COPD	2	6.90	1	4.17
Steroids	4	13.79	8	33.33
Alcohol	5	17.24	10	41.67
Smoking	6	20.69	6	25.00
Enteral feeds	12	41.38	8	33.33
Reintubation	3	10.34	5	20.83
Advanced age	2	6.90	11	45.83
Sepsis	2	6.90	4	16.67
Malignancy	0	0.00	1	4.17

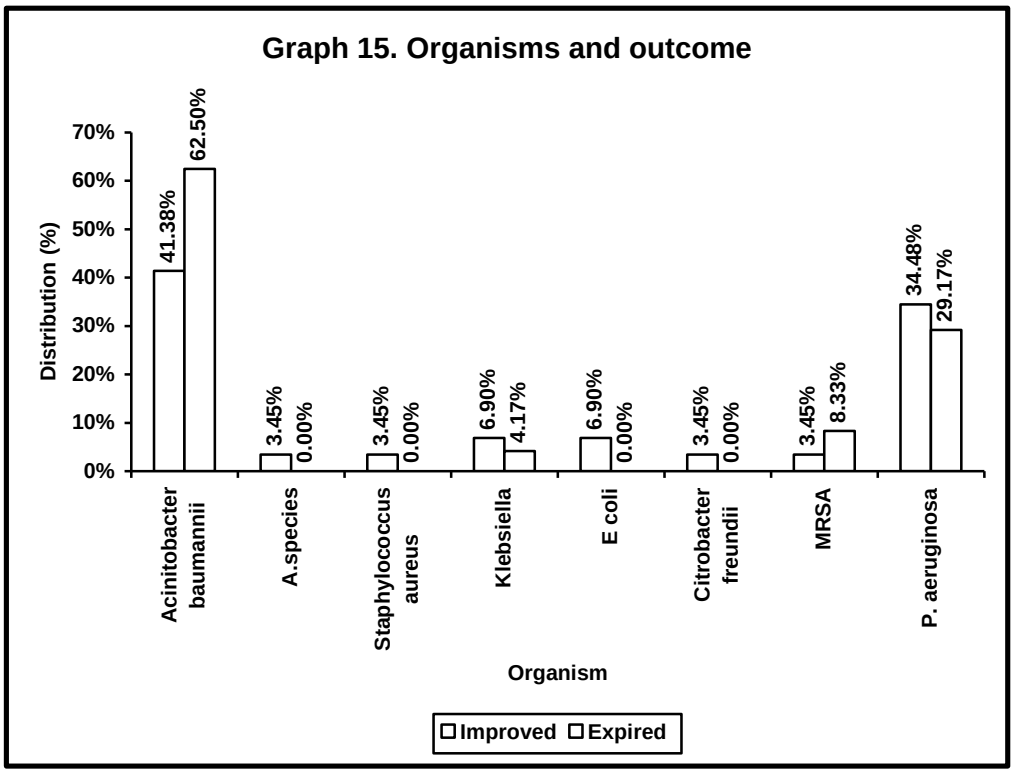


In this study, majority of the patients who expired had advanced age (45.83%) followed by alcohol consumption (41.67%), steroids and enteral feeds (33.33% each) as risk factors.

Table 16. Organisms and outcome

Organism	Improved (n=29)		Expired (n=24)	
	No.	Percentage	No.	Percentage
Acinitobacter baumannii	12	41.38	15	62.50
Staphylococcus aureus	1	3.45	0	0.00
Klebsiella	2	6.90	1	4.17
E coli	2	6.90	0	0.00
Citrobacter freundii	1	3.45	0	0.00
MRSA	1	3.45	2	8.33
P. aeruginosa	10	34.48	7	29.17

x^2=2.703 **DF=2** **p=0.259**

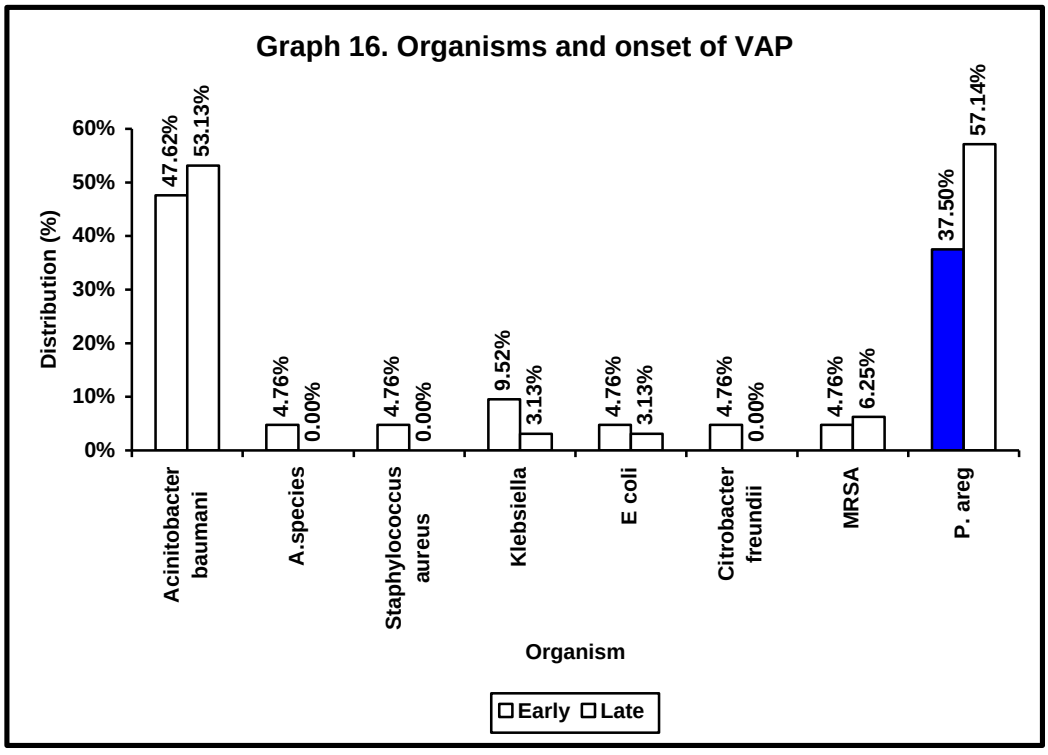


A. baumannii and P. aeruginosa accounted for 62.50 % and 29.17% mortality.

Table 17. Organisms and onset of VAP

Organism	Early (n=21)		Late (n=32)	
	Number	Percentage	Number	Percentage
A. baumannii	10	47.62	17	53.13
A. species	1	4.76	0	0.00
P.aeruginosa	5	37.50	12	57.14
Staphylococcus aureus	1	4.76	0	0.00
Klebsiella	2	9.52	1	3.13
E coli	1	4.76	1	3.13
Citrobacter frondi	1	4.76	0	0.00
MRSA	1	4.76	2	6.25

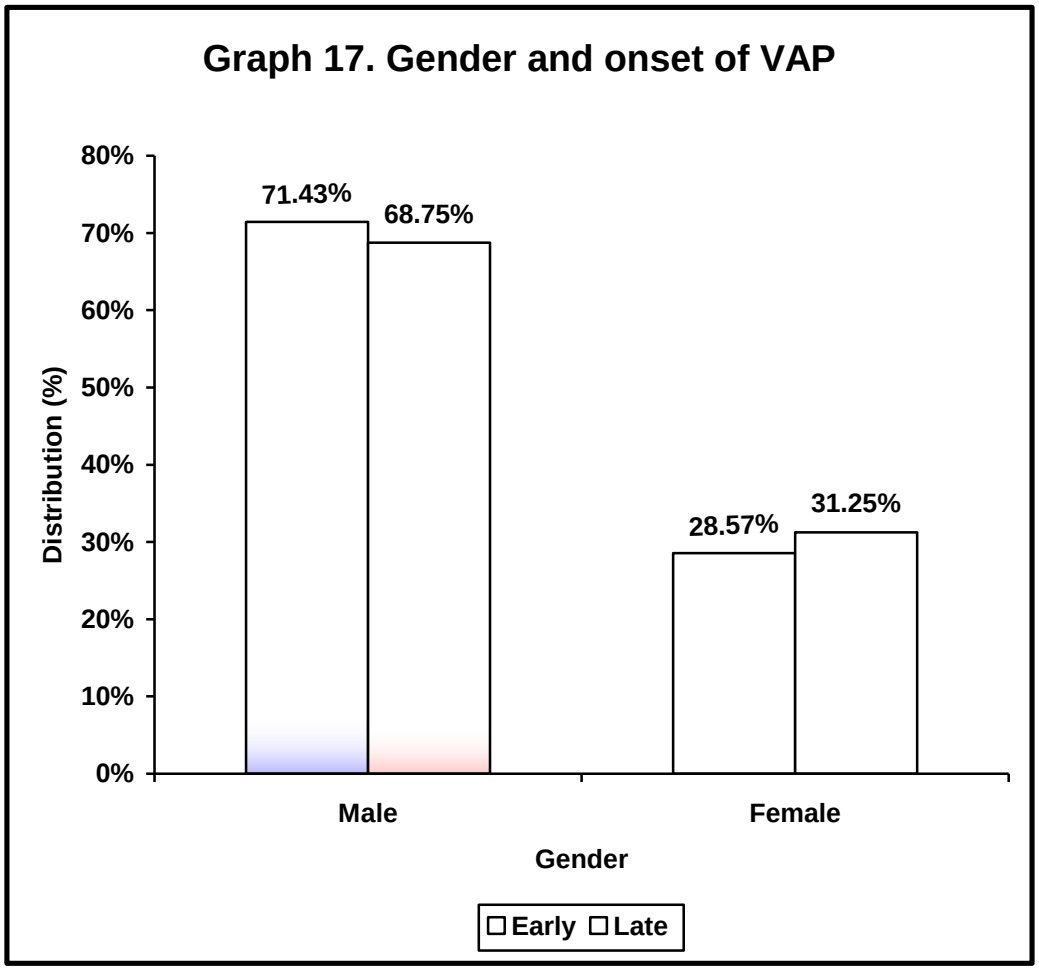
x^2=2.384 **DF=2** **p=0.303**



A. baumannii and P. aeruginosa were the major causative organisms in both early VAP and late VAP.

Table 18. Gender and onset of VAP

Gender	Early (n=21)		Late (n=32)	
	Number	**Percentage**	**Number**	**Percentage**
Male	15	71.43	22	68.75
Female	6	28.57	10	31.25
Total	**21**	**100.00**	**32**	**100.00**
x^2=0.043		**DF=1**		**p=0.835**

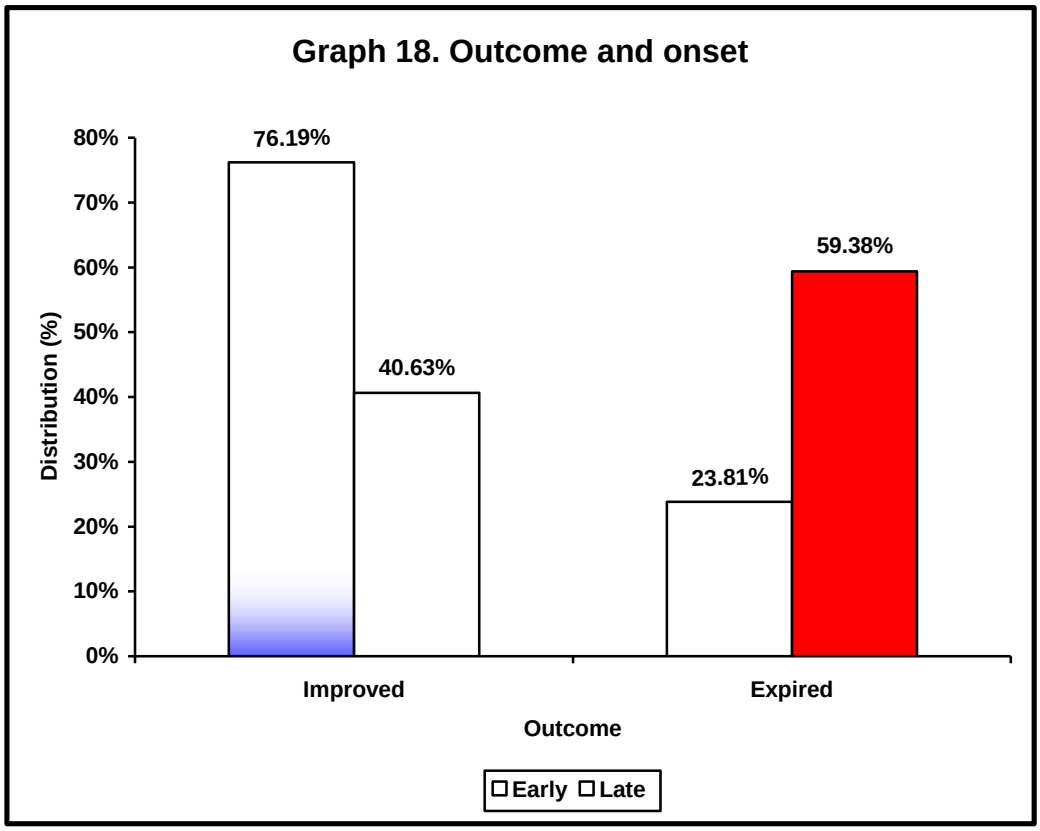


Male predominance was seen in both early onset and late onset VAP.

Table 19. Outcome and onset

Outcome	Early (n=21)		Late (n=32)	
	No.	**Percentage**	**No.**	**Percentage**
Improved	16	76.19	13	40.63
Expired	5	23.81	19	59.38
Total	**21**	**100.00**	**32**	**100.00**

x^2 = 6.4722 DF = 1 p=0.011



Five patients (23.81%) out of 21 who developed early VAP expired and 19 patients (59.38%) out of 32 who developed late VAP expired suggesting mortality was high with late onset of VAP (p=0.011).

Table 20. Antibiotic susceptibility pattern of Gram negative isolates

Antibiotic susceptibility		A. baumannii	A. species	P. aeruginosa	K.pneumoniae	E.coli	C. freundii
Imipenem	S	2		7	3	1	1
	R	25	1	8		1	
Cephalexin	S						
	R				3	1	1
Piperacillin-tazobactam	S	17		13	3		1
	R	8	1	4		1	
Aztreonam	S	2		2		1	
	R	28	1	15	2	1	1
Amoxyclav	S	-	-	-	1	-	-
	R	1	-	-	1	2	1
Doxycycline	S	15	1	-	-	-	-
	R	11	-	-	-	-	-
Cefotaxime	S	-	-	-	-	-	-
	R	1	-	-	-	-	-
Meropenem	S	-	-	-	-	-	-
	R	1	-	-	-	-	-

Most of the gram negative organisms isolated in this study were multidrug resistant.

Table 21. Antibiotic susceptibility pattern of Gram positive isolates

Isolates	No. of isolates	Penicillin		Erythromycin		Cephalexin		Cotrimoxazole		Ciprofloxacin		Clindamycin	
		S	R	S	R	S	R	S	R	S	R	S	R
S.aureus	4	-	4	-	4	1	3	-	4	-	4	1	3

Table 22. Antibiotic susceptibility pattern of Gram positive isolates

Isolates	No. of isolates	Linezolid		Amoxyclav		Cefotaxime		Doxycycline		Vancomycin	
		S	R	S	R	S	R	S	R	S	R
S.aureus	4	1	2	-	3	3	-	3	-	3	-

S. aureus was found to be sensitive to cefotaxime, doxycycline and vancomycin.

Table 23. S. aureus isolates

Total no. of S. aureus isolated	MRSA isolated	MSSA isolated
4	3	1

Out of the 4 isolates of staphylococcus aureus 3 were methicillin resistant.

Table 24. Metallo-beta lactamase producing Pseudomonas aeruginosa isolates

Total number of Pseudomonas aeruginosa isolates	MBL producers	Non MBL producers
17	8 (47.06%)	9 (52.94%)

Out of the 17 isolates of P.aeruginosa 8(47.06%) were metallobetalactamase producers.

Table 25. Isolates in patients with risk factors

Isolates	Risk factors					
	Steroids	Re intubation	Enteral feeds	Alcohol	Smoking	Diabetes mellitus
A. baumannii	5 (41.67%)	3 (37.50%)	9 (60.00%)	9 (60.00%)	5 (41.67%)	5 (55.55%)
Klebsiella	3 (25.00%)	2 (25.00%)	1 (6.67%)	1 (6.67%)	2 (16.67%)	-
P. aeruginosa	2 (16.67%)	2 (25.00%)	3 (20.00%)	3 (20.00%)	3 (25.00%)	3 (33.33%)
Staph. aureus	1 (8.33%)	-	-	-	-	-
MRSA	1 (8.33%)	-	1 (6.67%)	1 (6.67%)	-	1 (11.12%)
E. Coli	-	1 (12.50%)	1 (6.67%)	1 (6.67%)	1 (8.33%)	-
A. species	-	-	-	-	1 (8.33%)	-

A. baumannii followed by P. aeruginosa were the most common organisms isolated in patients with risk factors.

Chapter 6

Discussion

DISCUSSION

This study was done to assess the etiology, clinical profile and risk factors associated with the development of Ventilator associated pneumonia in the ICU of KLES Dr Prabhakar Kore Hospital and Medical Research Centre, Belgaum.

Patients who were admitted to medical ICU and were mechanically ventilated for more than 48 hours were included. Patients who had features suggestive of pneumonia prior to intubation were excluded.

Patients who were on mechanical ventilation for more than 48 hours and who developed fever, raised leukocyte count and infiltrates on x-ray were included.

The endotracheal aspirate was collected using a mucous extractor, gram staining and quantitative culture of this aspirate was done using a cut off value of 10^5 cfu/ml. Studies have shown that quantitative bacteriological methods have increased the reliability of sputum specimens for the diagnosis of lower respiratory tract infections when compared with conventional qualitative cultures because of more careful collection of sputum and the method of dilution which eliminates contaminating oropharyngeal secretions.[71]

Marquette[76] et al in their study comparing ET aspirate cultures with PSB found that the cut off value of 10^6 cfu/ml, the former technique could be used as a reliable alternative to Protected specimen brush (PSB). These findings compare favorably with our study where we had used the quantitative cultures of the ET aspirates at a cutoff point of 10^5 cfu/ml. Since protected specimen brush and

bronchoalveolar lavage were not available to us, the endotracheal aspirate quantitative technique was used as an alternative diagnosis.

A total of 54 samples were collected out of which one was contaminated and the patient has expired before another sample was collected so a total of 53 patients were studied.

Of the 53 patients who developed VAP 37 (69.81%) were male and 16 (30.19%) were female. In a study conducted by Eleni Apostolopoulou[27] et al 71% were male and 29% were female. In a study conducted in India by Joseph et al 66.7 % were male and 33.3 % were female.[88]

In our study the age of the patients ranged from 18 to 84 years with a mean ± SD 46.40 ± 18.45. Bimodal distribution of age was observed with the first peak between 18-30years age group, the second peak from 41-50 years age group. The Patient profile of our study including the age, gender was most similar to the study conducted in Athens by Eleni Apostolopoulou[27] et al in the year 2003.

Out of the 53 patients who developed VAP 10 of them had neurological conditions like stroke (five cases), GBS (three), epilepsy (one), myasthenia gravis (one), infectious diseases were nine out of which malaria (four), dengue (three), viral encephalitis (two), six cases were poisoning and six cases were sepsis.

We observed that Gram negative organisms were the predominant causative flora in our VAP patients, with Acinetobacter (50.04%) being the

commonest followed by Pseudomonas (32.08%), Klebsiella, E. Coli, Coagolase negative Staph aureus. This is similar to trends reported previously.

A study conducted in India showed a similar predominance of Gram negative organisms with Pseudomonas (52%), E. Coli (23%), Klebsiella (9%), Acinetobacter (4%).[33]

Our study shows incidence of more cases of VAP due to A. baumannii compared to Pseudomonas whereas most of the studies shows higher incidence of pseudomonas this can be explained as follows.

As this is a tertiary care center most of the patients here are referred from a primary care physician after treating for few days with antibiotics, most commonly used antibiotics are third generation cephalosporin and fluroquinolones.

A study conducted by Mulin et al[89] showed the association of third generation cephalosporin with colonization and infection with A.baumanni. Previous use of Fluroquinolones antibiotics was a risk factor found for the development of endemic A. baumannii infection. Lortholary et al[90] noted that 75% of patients who were colonized or infected with Acinetobacter had previously taken antimicrobials.

Acinetobacter are particularly important as causes of outbreaks and are readily spread from one patient to another. This appears to be due to their ability to survive on health-care workers' hands and inanimate environmental

surfaces.[91-94] and their intrinsic resistance to many common antibiotics.[95-98] rather than any potent virulence factors aimed at host defenses.

Several studies have reported that more than 60% of VAP is caused by aerobic Gram negative bacteria.[43,49,57,99] The data from other investigations conducted with ventilated patients, for whom bacteriologic studies were restricted to uncontaminated specimens, confirmed those results: GNB represented 58% of recovered organisms.[17,54,57,66] The predominant GNB were Pseudomonas and Acinetobacter spp., followed by Proteus spp., E. Coli, Klebsiella spp., and H. Influenzae. A relatively high rate of gram-positive Pneumonias was also reported in those studies, with S. aureus involved in 20% of the cases.[17,57] Microorganisms responsible for VAP may differ according to the population of patients in the ICU, the durations of hospital and ICU stays, and the specific diagnostic methods used.

Patients were divided into early onset (developing within five days of intubation) and late onset (after five days of intubation) VAP. Out of the 53 patients 21 (39.62%) developed early onset and 32 (60.38%) developed late onset VAP. In a prospective study conducted in India incidence of early onset VAP was 47.17% and late onset VAP was 52.3% which was almost similar to our study.[100]

The organisms in early onset VAP were different from the late onset group The community acquired organisms such as Streptococcus pneumoniae, Haemophilus Influenzae and Methicillin Sensitive Staph aureus were the frequent

cause of early onset VAP as against Acinetobacter, Pseudomonas, Klebsiella species encountered in late onset VAP.[43]

In our study we observed that Acinetobacter and pseudomonas were the major organisms which were isolated in both early and late VAP.

Acinetobacter caused 47.62% of early onset and 53.13% of late onset VAP, where as pseudomonas caused 37.50% of early onset and 57.14% of late onset VAP.

In a study conducted by Ibrahim et al organisms for both early and late onset VAP were similar.[101]

The microbial flora associated with VAP represents the common organisms present in the gut, oropharynx and environment (Gram negative). Colonization in patients on ventilator has been recognized as an important source for these Gram negative infections.

Since ventilator associated pneumonia accounts for significant morbidity and mortality, broad spectrum antibiotics are used empirically and this further enhances the chance for individual patients to be colonized with resistant organisms.

Johanson[48] and coworkers studied the same relationship and found an incidence of VAP of 23% in colonized as against 3% in non colonized patients.Our findings revealed that, of the patient's having ET colonisation more than half were due to Gram negative organisms. Hence the increased incidence of

Gram negative VAP in our study is indicative of the pattern of colonization seen in our intubated patients.

Strict antibiotic policies have to be laid down for the ICU so as to restrict the use of empiric broad spectrum antibiotics. This will reduce the frequency of colonization. The knowledge of common organisms in ICU and their antibiotic susceptibility is important for institution of appropriate antimicrobial therapy.

Risk factors in these patients were analyzed. All patients who were mechanically ventilated were catheterized with self retaining catheter and nasogastric tube was placed in all of them, though all of them did not receive enteral feeds.

Enteral nutrition has long been considered a risk factor for development of VAP, mainly because of an increased risk of aspiration of gastric contents as shown in studies conducted by Ferrer et al.[57] Enteral feeding may predispose to VAP by elevating gastric pH, leading to gastric colonization and causing gastric distention, thus increasing the risk of reflux and aspiration.[27,84,101,102]

All the patients as a routine were given proton pump inhibitors for stress ulcer prophylaxis.

Recent data in the outpatient setting suggest an increased risk for community acquired pneumonia in current users of acid-suppressive medication (both proton- pump inhibitors and histamine2 receptor antagonists).[103-105]

A cohort study conducted in outpatient population of united kingdom[105] showed that the highest risk for community-acquired pneumonia was within the

first two days of proton-pump inhibitor therapy, and there was a statistically significant association up to 30 days after newly started therapy but no significant association thereafter. Another study[103] similarly found higher risk among persons who started proton-pump inhibitor use within the prior seven days.

All mechanical ventilated patients were in supine position, head end elevation and prone position ventilation were not followed in our hospital setting.

Supine patient positioning may also facilitate aspiration, which may be decreased by a semirecumbent positioning.[106-109] Using radioactive labeled enteral feeding, cumulative numbers of endotracheal counts were higher when patients were placed in the completely supine position (0^0) as compared with a semi recumbent position (45^0).[106,107]

One randomized trial demonstrated a threefold reduction in the incidence of ICU-acquired HAP in patients treated in the semirecumbent position compared with patients treated completely supine.[26]

Infection in patients in the supine position was strongly associated with the simultaneous administration of enteral nutrition. Thus, intubated patients should be managed in a semirecumbent position, particularly during feeding.

All the patients at the time of intubation were given sedatives and neuromuscular blockers (atracurium and vecuronium). Patients who were kept on volume control mode were given sedation and neuromuscular blockers continuously with exception being OP poisoning and GBS.

Hand washing protocol was not routinely followed in our MICU setting. The oldest measure to prevent nosocomial infection in health care institutions is hand hygiene.[110] Austin et al reported that the prevalence of vancomycin-resistant enterococci colonization dropped from a predicted 79% to an observed 36% after implementation of infection-control measures, "the most important of which were hand-washing and cohorting of staff."[110,111]

Despite universal acknowledgment of hand-washing as a cornerstone of nosocomial infection-control programs, compliance rates >50% have been difficult to achieve, and hand-washing rates have ranged from 9% to 50% in studies of health care workers.[112,113]

Reasons for poor compliance identified in one study were drying and irritation, inconvenient sink locations, time constraints, high work load, and understaffing.[112]

Alcohol-based, waterless hand rubs or gels are now advocated by the Centers for Disease Control and Prevention for hand hygiene because of their convenience and broadspectrum activity, but also because they appear to preserve hand condition better than antiseptic soap and water.[114] A vigorous one-minute rubbing with a sufficient volume of alcohol to wet the hands completely has been shown to be highly effective at reducing the density of skin flora.[115-118]

Use of steroids, sedatives and skeletal muscle relaxants, supine position, enteral feeds, elderely age, COPD, trauma tube thorocotomy, head injury were all found to be risk factors in various multivariate analysis.

In our study the most common organisms isolated in patients with risk factors were Acinitobacter followed by pseudomonas.

Various pathogens with associated risk factors tabulated from various multivariate studies are as follows

Pathogen	Risk factors
Streptococcus pneumoniae [3,6]	Smoking, COPD, absence of antibiotic therapy
Haemophilus influenzae[119]	Smoking, COPD, absence of antibiotic therapy
Staphylococcus aureus[120-122] (MSSA)	Younger age, Traumatic coma Neurosurgery
Staphylococcus aureus (MRSA)[123,124]	COPD, Steroid therapy, Longer duration of mechanical ventilation, Prior antibiotic therapy, Prior bronchoscopy
Pseudomonas aeruginosa [6,125]	Steroid therapy, Longer duration of mechanical ventilation, Prior antibiotic therapy , COPD
Acinetobacter species [126,127]	Head trauma, Neurosurgery, Gross aspiration, Prior cephalosporin therapy, ARDS

Out of the 53 patients 19 of them developed right lobar consolidation, 14 developed bilateral bronchopneumonia, 11 developed left lobar consolidation ,5 developed bilateral consolidation, three developed left upper and lower zone consolidation three, right upper, mid and lower zone consolidation.

The probable reason why Right sided pneumonia is high in our study is the right bronchus is short and straight in continuation with trachea compared to left, patients were kept in supine position throughout their ventilation period hence the chance of aspiration is more.

Out of the 19 organisms isolated from bilateral pneumonia nine were Acinitobacter species and eight were pseudomonas.

Out of the 53 patients who developed VAP 51% of them developed between 5 to 10 days and 39.62% developed within four days of mechanical ventilation 48 (90.56%) out of 53 patients developed VAP within the first two weeks of mechanical ventilation. This is in correlation with the studies conducted by Apostolopoulou[27] E et al in four multidisciplinary ICU's in Athens, Greece. And In an Indian study conducted by Joseph NM et al 94% of patients developed VAP with in the first two weeks of mechanical ventilation.[88]

Out of the 53 patients 21 (39.62) of them developed early onset VAP and 32 (60.38%) of them developed late onset VAP. Acinetobacter and pseudomonas were the major organisms which were isolated in both early and late VAP.

Antibiotic susceptibility pattern of these isolates were studied. Out of the 27 species of Acinetobacter baumannii species isolated 27 were resistant to

Ciprofloxacin, 26 were resistant to Co-trimoxazole and Amikacin, 23 were resistant to Ceftazidime, 25 were resistant to Imipenem and Aztreonam.

Acinetobacter baumannii was found to be sensitive to Piperacillin-tazobactam and Doxycyclin.

Out of the 17 isolates of Pseudomonas aeruginosa- 17 of them were resistant to Co-trimoxazole, 14 to Ciprofloxacin and Amikacin, 15 were resistant to Aztreonam and 8 to Imipenam.

Pseudomonas was found to be sensitive to Ceftazidime and Piperacillin-tazobactam and half of them were sensitive to Imipenem.

Out of the 17 isolates eight isolates of Pseudomonas aeruginosa were plasmid-mediated metallo-beta lactamase enzyme producers, which is detected by imipenem-EDTA combined disk method.

Klebsiella pneumoniae was found to be resistant to Ciprofloxacin, Co-trimoxazole, Amikacin, Ceftazidime and Cephalexin.

All the isolates of Klebsiella were sensitive to Imipenem and Piperacillin-tazobactam.

Out of the four species of Staphylococcus aureus three were Methecillin resistant and one was Methecillin sensitive. Staph aureus was sensitive to Cefotaxime, Doxycyclin and Vancomycin.

Previously reported risk factors for VAP caused by MDR P. aeruginosa and other GNB and MRSA strains include prior use of antibiotics, prolonged

hospitalization, previous hospitalization and mechanical ventilation lasting more than 7 days.[128-132]

Out of the 53 patients who developed VAP 29 (54.72) of them survived and 24 (45.28) expired. Out of the 37 males, 16 (66.67) of them expired and 8 (33.33%) out of the 16 female expired. There was no statistical significance p value was 0.650. Of the 29 patients who survived two were greater than 60 years and of the 24 patients who expired 11 were greater than 60 yrs of age which was statistically significant ($p<0.001$).

Acinetobacter baumannii and Pseudomonas aeruginosa accounted for 62.50% and 29.17% mortality respectively which could not attain statistical significance.

Out of the 27 males who developed VAP, 15 were early onset and 22 were late onset. Out of the 16 females who developed VAP, 6 were early onset and 10 were late onset, there was no statistical significance ($p=0.835$).

Out of the 21 patients who developed early onset VAP, 5 (23.81) of them expired and of the 32 patients who developed late onset VAP, 19 (59.38%) of them expired, there was a statistical significance ($p= 0.011$).

The conclusions that can be drawn from the present study are routine protocol of culturing endotracheal aspirate is not followed in our ICU, Quantitative culture is not done routinely which if followed routinely the use of antibiotics, emergence of multidrug resistant strains can be reduced and out come of the patients with VAP will improve.

Empirical antibiotic treatment which can be administered in our MICU are Piperacillin tazobactam and Doxycyclin to cover gram negative isolates like Acinetobacter and pseudomonas. Cefotaxime and Doxycyclin to cover gram positive isolates like Staph aureus.

Occurrence of VAP can be decreased in our ICU by implementing following interventions like – use of semi recumbent position where possible and few hours after giving feed, using sucralfate instead of proton pump inhibitor, implementing hand washing, subglottic drainage.

Limitations of the study were it was done in ICU set up of single center, smaller sample size (Inadequate to draw statistical significance), duration of the study period (only one year) and study design (it was a cross-sectional observation study). Also non VAP patients were not studied to compare the role of risk factors and anaerobic cultures were not done.

Chapter 7

Conclusion

CONCLUSION

1. The present study gives over view of present disease scenario of Ventilator –associated pneumonia in our ICU.
2. Males were more affected than females (69.81% vs 30.19% respectively).
3. Bi-modal distribution of age was observed between 18 to 30 years and 41 to 50 years.
4. Risk factors identified were supine position, advanced age, steroids, alcohol consumption, enteral feeds, reintubation, sepsis.
5. 21 of them developed early onset and 32 developed late onset VAP.
6. Multidrug resistant Acinetobacter baumanii and Pseudomonas aeruginosa were the most common organisms isolated in both early onset and late onset VAP.
7. Mortality was more in patients with late onset VAP (59.38%).
8. Mortality was more in elderly patients who developed VAP (45.83%).
9. Acinetobacter baumanii was found to be sensitive to Piperacillin tazobactam and doxycyclin.

10. Pseudomonas was found to be sensitive to ceftazidime and Piperacillin-tazobactam and half of them were sensitive to imipenem.

11. Staph aureus was sensitive to cefotaxime, doxycyclin and vancomycin.

Chapter 8

Summary

SUMMARY

A total of 53 patients who were aged greater than 18 years and who developed VAP were studied. It was observed that males were more affected than females.

1. A bimodal distribution of age was observed.

2. 35.84 % of them developed bilateral and 35.85 % of them developed right sided pneumonia.

3. Organisms isolated in early VAP were Acinetobacter (47.62%), Pseudomonas (37.50) followed by Klebsiella (10%), E coli (4.76), Staph aureus (4.76), citrobacter (4.76%).

4. Organisms isolated in late VAP were Acinetobacter (53.13%), Pseudomonas (57.14%), MRSA (6.25%), E. coli and Klebsiella (3.13%) each.

5. Acinetobacter and pseudomonas were the common organisms found in both early and late VAP.

6. Risk factors identified in patients were supine position (100%), stress ulcer prophylaxis (100%) enteral feeds (37.74%), alcohol (28.30%), steroids (22.64%), smoking (22.64%) reintubation (25.09%), reintubation (15.09%) advanced age (20.75%).

7. 90.56% of patients developed VAP with in the first two weeks.

8. 11 of the 13 patients who were greater than 60 years expired.

9. Mortality in late onset VAP was 59.38% and early onset VAP was 23.81%.

10. Out of the Acinetobacter and Pseudomonas isolated majority of them were multidrug resistant isolates.

11. Out of the 17 isolates of Pseudomonas 47.06% of them were metallo-beta lactamase producers.

12. Acinetobacter isolated in our ICU was resistant to ciprofloxacin, cotrimoxazole, amikacin, ceftazidime, imipenem and aztreonam.

13. Acinetobacter baumanii was found to be sensitive to Piperacillin-tazobactam and doxycyclin.

14. Pseudomonas isolated in our ICU was resistant to to ciprofloxacin, cotrimoxazole, amikacin, and aztreonam.

15. Pseudomonas was found to be sensitive to ceftazidime and Piperacillin tazobactam and half of them were sensitive to imipenem.

The incidence of patients who are being admitted to ICU and requiring mechanical ventilation is increasing. Knowledge of incidence of VAP, risk factors and their causative microbial flora in a local setting would be important to ensure more effective utilization of antibiotics and thereby, a better outcome. It would also allow formulation of strategies to decrease the incidence of VAP. There is a need for many more hospital based prospective studies in our country.

Chapter 9

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Annexures

Annexure I

ANNEXURE I – CONSENT FORM

INFORMED CONSENT FOR PARTICIPATION IN RESEARCH

As your patient is put on a machine which will provide him with respiration and as he is not in apposition to give the consent for participation into the study and as you are the well-wisher and care taker of the patient we request you to give your consent to enroll your patient into the study titled "**STUDY OF CLINICAL PROFILE, ETIOLOGY AND OUTCOME OF VENTILATOR ASSOCIATED PNEUMONIA CONDUCTED IN KEL'S DR. PRABHAKAR KORE HOSPITAL AND MRC, BELGAUM. A ONE YEAR CROSS SECTIONAL STUDY"**

OBJECTIVE OF THE STUDY

The objective is To study the chest infections which are known to occur in patients put on mechanical ventilator through a tube put into the wind pipe which will help[p to aerate the lungs, as your patient is put on ventilator we request you to recruit him into the study. The principal investigator of the study is Dr. Prakash K Phadnis MD and the co-investigator is Dr. Chandramouli Reddy. Dept of MEDICINE, Belgaum KLES Dr. Prabhakar Kore Hosptial and Medical Research Centre, KLE University, Belgaum.

PROCEDURES INVOLVED

Here we are going to collect the secretions from the tube (endotracheal tube) which is placed in the wind pipe and are going to subject it for culture. This

procedure will be done at least twice. This is not going to cause any discomfort, temporary or long lasting problems to your patient.

WITHDRAWL FROM STUDY

Your participation in research is voluntary. Your decision whether or not to participate in the study will not affect your relationship with Jawaharlal Nehru Medical College. If you decide to participate you are free to withdraw at any time and you will not be penalized in any way.

RISK AND BENEFITS

There are no extra risks involved in this procedure. This may be of some benefit to your patient.

PRIVACY AND CONFIDENTIALITY

The only people to know that you are a research subject are members of the research team. No information about you or provided by you during research will be disclosed to others without your written permission, except :

1. In emergency to protect your rights and welfare.
2. If required by law.

AUTHORIZATION TO PUBLISH RESULTS

When the results of the research are published or discussed, in a conference no information will be displayed that would disclose your identity. Any information that is obtained in connection with this study and that can be identified with you will remain confidential.

FINANCIAL INCENTIVES FOR PARTICIAPTION

You will not pay/offer any free gifts for participating in the research. You will not be reimbursed for expenses.

I undersigned_____ have been explained in my vernacular language about the study and inclusion of may patient in the study is voluntary. If I want, I can withdraw at any time. Also I have been given enough time to clear my doubts and right s as study participant.

In case you have any questions related to the study, you can contact Dr. K. Chandramouli Reddy (Mobile No. 9620651735).

In case you have any questions about your rights as a study participant, you can contact Dr. V. D. Patil.

CONSENT STATEMENT

Signature or left hand thumb print of participant or legally authorized representative.

Participants Name _____

Name of legally authorized representative _____

Signature _____

Witness name _____ Signature _____

Experimenters Name Signature _____

Date :

Place :

Annexures

Annexure II

ANNEXURE II – PROFORMA

Topic: **"STUDY OF CLINICAL PROFILE, ETIOLOGY AND OUTCOME OF VENTILATOR ASSOCIATED PNEUMONIA - A ONE YEAR CROSS-SECTIONAL STUDY"**

Name: Dr. K. CHANDRAMOULI

Identification Data

Date of admission	Date of discharge
IP No:	
Name of the Patient:	Age:
Sex:	Father's/ Husband's Name:
Address:	
Occupation	Religion

Brief clinical history

Symptoms:

Co-existing Medical Problems, if any:

Diabetes mellitus	Hypertension
COPD	Bronchial asthma
Bronchitis	Tuberculosis
Chronic renal failure	Malignancy

Personal History:

Smoking	Alcohol

Family History:

Physical Examination:

Pallor - Icterus –

Cyanosis - Clubbing –

Lymphadenopathy - Edema –

JVP

Peripheral pulses:-

Pulse

BP:

Systemic Examination:

CVS:

Respiratory:

CNS:

P/A:

Investigations:

1. Chest x ray
2. Leucocyte count
3. Temperature
4. Pao2/Fio2
5. Tracheal secretions
6. Endotracheal aspirate culture
7. Renal function tests

Liver function test

Diagnosis at admission:

Days in ICU:

Days of Study:

Days with mechanical ventilator:

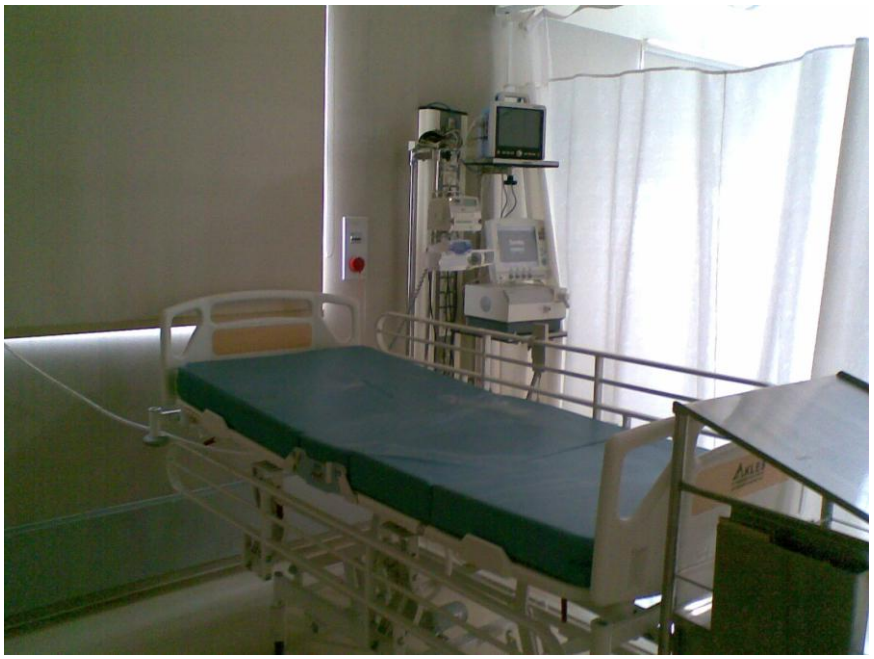
In hospital mortality:

Annexures

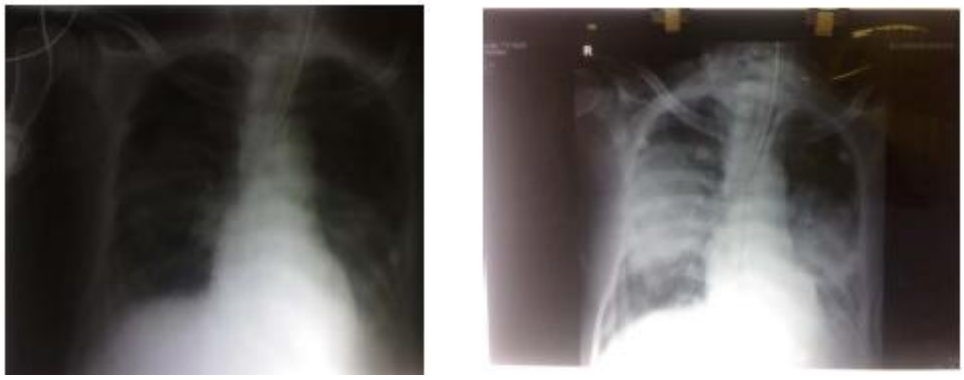
Annexure III

ANNEXURE III – PHOTOGRAPHS

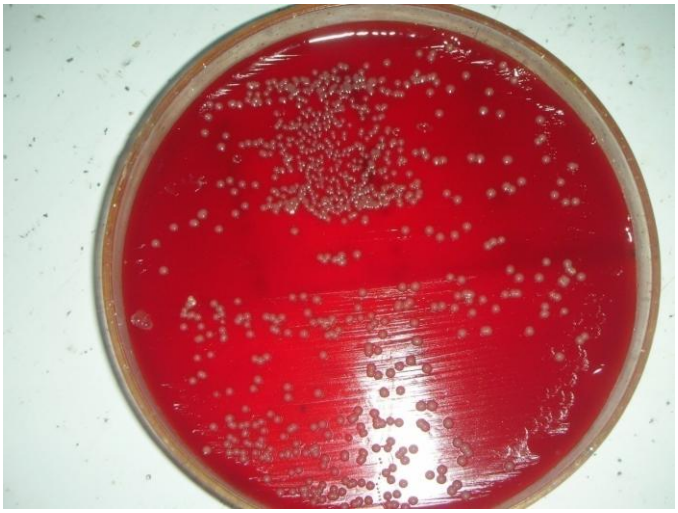
Photograph 1. Mucous extractor used for collecting endotracheal aspirate



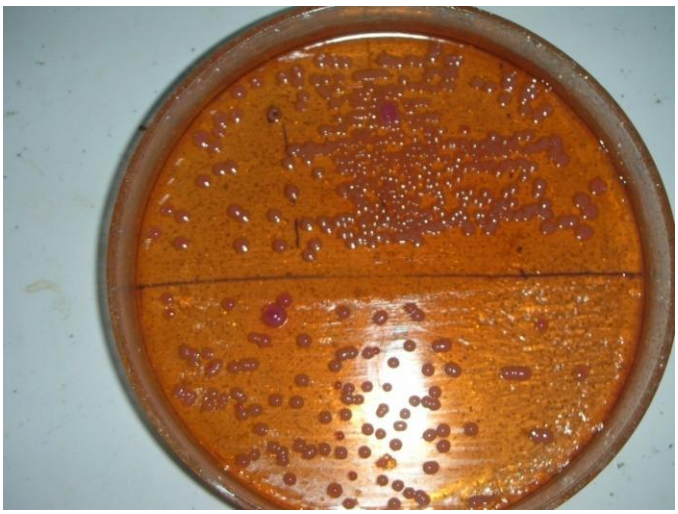
Photograph 2. ICU Set up



Photograph 3. Chest X-ray of patient before and after development of VAP



Photograph 4. Blood agar plate



Photograph 5. MacConkey agar plate

ANNEXURE IV - MASTER CHART

Sl. No.	IP NO.	Age (Years)	Sex	Date of admission	DM	HTN	COPD	Steoroids	Alcohol	Smoking	Enteral feeds	Temperature	TLC (/mm3)	Tracheal secretions	Chest X-ray	Blood culture	Penicillin	Oxacillin	Erythromycin	Clindamycin	Cefotaxime	Linezolid	Vancomycin	Cephalexin	Ciprofloxacin	Cotrimoxazole	Amoxyclav
1	349027	34	M	06.01.10	N	N	N	N	Y	N	N	100.4	15,800	purulent	RLC	A. bau	-	-	-	-	-	-	-	-	R	R	-
2	351205	58	M	24.01.10	Y	N	N	N	Y	N	N	101	21,600	purulent	RLC	A. bau	-	-	-	-	-	-	-	-	R	R	-
3	352110	55	F	07.02.10	N	Y	N	N	N	N	Y	101.8	12,000	purulent	LLC	MRSA	R	R	R	R	S	R	S	R	R	R	R
																C. Frau								R	I	R	S
4	359460	75	F	30.03.10	N	N	N	N	N	N	Y	101.4	14,500	purulent	Bl Br Pn	P. aeru	-	-	-	-	-	-	-	-	R	R	-
5	373058	47	M	29.06.10	N	N	N	N	N	N	Y	101.2	15,000	purulent	LLC	A. bau	-	-	-	-	-	-	-	-	R	R	-
6	372725	26	F	30.06.10	N	N	N	N	N	N	N	101	20,000	purulent	RT-U,M,LL , LT-U,LL	A. bau	-	-	-	-	-	-	-	-	S	R	-
																P. aeru									R	R	
7	372508	30	M	29.06.10	N	N	N	N	N	N	Y	101.2	11,300	purulent	LLC	A Bau	-	-	-	-	-	-	-	-	S	S	-
8	374738	27	F	14.07.10	N	N	N	N	N	N	N	102	27,800	purulent	LLC	P. aeru	-	-	-	-	-	-	-	-	R	R	-
9	370372	54	M	26.07.10	N	N	Y	Y	Y	Y	N	100.4	12,000	purulent	RLC	Kleb	-	-	-	-	-	-	-	-	R	S	-
10	379707	18	F	14.08.10	N	N	N	Y	N	N	N	101.6	17,000	purulent	LLC	Kleb	-	-	-	-	-	-	-	-	R	R	-
11	381738	45	M	27.08.10	N	N	N	N	Y	N	N	101.4	18,100	purulent	LLC	E Coli	-	-	-	-	-	-	-	R	R	R	S
12	383546	24	M	10.09.10	N	N	N	N	N	N	Y	102	22,000	purulent	LLC	P. aeru	-	-	-	-	-	-	-	R	R	R	I
13	384676	35	F	19.09.10	N	N	N	N	N	N	N	102	12,000	purulent	RLC	P. aeru	-	-	-	-	-	-	-	R	R	R	R
14	384281	48	M	01.10.10	Y	Y	Y	Y	N	N	N	100	10,300	purulent	Lt-U,LL	S.Aureus	-	-	-	-	-	-	-	-	R	R	-
15	386594	86	M	01.10.10	N	N	N	N	Y	Y	N	102.4	13,900	purulent	Bl Br Pn	P. aeru	-	-	-	-	-	-	-	-	R	R	-
16	387212	63	F	06.10.10	N	N	N	N	N	N	Y	101.6	36,800	purulent	RLC	A.Bau	R	S	R	S	-	-	-	S	R	R	-
17	385724	35	M	25.09.10	N	N	N	N	N	N	N	100.4	22,300	purulent	RLC	A Bau	-	-	-	-	-	-	-	-	R	R	-
18	0387924	68	M	11.10.10	N	N	N	N	N	N	N	101	26,100	purulent	RLC	A Bau	-	-	-	-	-	-	-	-	S	R	-
19	0389167	70	F	30.10.10	N	N	N	N	N	N	N	100.2	16,000	purulent	RLC	A Bau	-	-	-	-	-	-	-	-	R	R	-
20	0391536	76	F	05.11.10	N	Y	N	N	N	N	N	101.2	16,000	purulent	RLC	A Bau	-	-	-	-	-	-	-	-	R	R	-
21	0390909	56	M	04.11.10	N	N	N	N	N	N	N	101	13,000	purulent	RLC	A Bau	-	-	-	-	-	-	-	-	R	R	-
22	391314	63	M	07.11.10	Y	Y	N	N	Y	Y	Y	101.2	11,000	purulent	RT-U,M,LL , LT UL	P. aeru	-	-	-	-	-	-	-	-	R	R	-
23	390900	23	M	02.11.10	N	N	N	Y	N	N	Y	100	9,800	purulent	Bl Br Pn	MRSA	-	-	-	-	-	-	-	-	I	R	-
24	393378	21	M	19.11.10	N	N	N	Y	N	N	N	101	900	purulent	Bl Br Pn	A.Bau	-	-	-	-	-	-	-	-	S	R	-
25	395187	35	F	03.12.10	N	N	N	Y	N	N	Y	101.2	12,600	purulent	RT- U,M,LL	A.Bau	R	R	R	R	S	S	S	R	R	R	R
26	395384	23	M	01.12.10	N	N	N	N	Y	N	Y	100.4	4,900	purulent	Bl Br Pn	A.Bau	-	-	-	-	-	-	-	-	R	R	-
27	395189	55	F	05.12.10	N	N	N	N	N	N	Y	101	780	purulent	LLC	P. aeru	-	-	-	-	-	-	-	-	S	R	-

ANNEXURE IV - MASTER CHART

Sl. No.	IP NO.	Imipenem	Amikacin	Aztreonam	Pipercillin-tazobactam	Ceftazidime	Doxycycline	Meropenem	MRSA	MBL	CPI Score		Antibiotics	Date of Intubation	Intubation (No of times	Mech Ventilation (Days	Onset	Outcome	DOC
1	349027	R	R	R	R	S	S	-	-	-	7		ML	inj .fortum(3rd gen cephalosorin)	08.01.10	1	16	3 Early	D	11.01.10
2	351205	R	R	R	R	S	S	-	-	-	7		INHALATION OF FUMES	ing.piptaz,inj azom	25.01.10	1	7	3 Early	D	20.01.10
3	352110	-	-	-	-	-	S	-	Pos	-	7		GBS	inj ciplox(fluroquinolones),mezol	07.02.10	1	10	3 Early	D	18.02.10
		S	R	R	S	S														
4	359460	R	R	R	S	R	R	-	-	-	7		GBS	inj.xone(3rd gen cephalosorin)	31.03.10	1	30	22 late	E	21.04.10
5	373058	R	R	R	S	R	R	-	-	-	7		SNAKE BITE	inj.acuclav,mezol	02.07.10	1	10	5 late	D	07.07.10
6	372725	I	R	R	S	S	-	-	-	P	7		POSTPARTUMSEPSIS	inj.piptaz	30.06.10	1	12	10 late	E	09.07.10
		R	R	R	I	R	S													
7	372508	S	S	S	S	S	S	-	-	-	7		GBS	inj.xone(3rd gen cephalosorin)	30.06.10	1	20	11 late	D	16.07.10
8	374738	R	R	R	R	R	-	-	-	NP	7		POSTPARTUMSEPSIS	inj.piptaz	14.07.10	1	9	4 early	D	17.07.10
9	370372	S	S	R	R	R	S	-	-	-	7		COPD	inj.xone(3rd gen cephalosorin)	26.07.10	2	6	3 early	D	28.07.10
10	379707	R	R	R	S	S	-	-	-	P	7		DENGUE	inj.fortum(3rd gen cepha)	15.08.10	2	15	13 late	E	27.08.10
11	381738	S	R	I	S	R	-	-	-	-	7		ACUTE PANCREATITIS	inj fortum(3rd gen cepha),inj.azom	29.08.10	1	10	4 early	D	01.09.10
12	383546	S	R	R	S	I	-	-	-	-	7		DENGUE	inj.fortum(3rd gen cephalosorin)	10.09.10	1	6	4 early	D	13.09.10
13	384676	S	R	R	R	S	-	-	-	-	7		UROSEPSIS	inj norflox(fluroquinolones	19.09.10	1	9	4 early	D	23.09.10
14	384281	S	S	S	S	S	-	-	-	NP	7		COPD	inj.levofloxacin(fluroquinolones	01.10.10	1	30	3 Early	D	04.10.10
15	386594	S	R	R	S	S	-	-	-	NP	7		BUCCAL CA	inj.fortum(3rd gen cephalosorin)	09.10.10	1	10	5 late	E	13.10.10
16	387212	-	-	-	-	-	-	-	Neg	-	7		M.ENCHEPHALOPATHY	inj.piptaz	08.10.10	1	10	6 late	E	13.10.10
17	385724	R	R	R	R	S	S	-	-	-	7		OPP	injxone(3rd gen cepha),mezol	25.09.10	1	8	3 Early	D	27.10.10
18	0387924	R	S	R	S	I	-	-	-	P	7		OBSTRUCTIVE UROPATHY	inj norflox(fluroquinolones ,inj amikacin	12.10.10	2	18	16 L	E	27.10.10
19	0389167	R	R	R	S	R	R	-	-	-	7		STATUS EPILEPTICUS	inj.xone(3rd gen cephalosorin)	01.11.10	1	13	8 L	E	09.11.10
20	0391536	R	R	R	S	R	R	-	-	-	7		CCF	(3rd gen cephalosorin)	06.11.10	1	10	4 early	D	10.11.10
21	0390909	R	R	R	S	R	R	-	-	-	7		DENGUE	inj fortum(3rd gen cephalosorin)	05.11.10	1	12	6 late	E	11.11.10
22	391314	R	R	R	S	R	R	-	-	-	7		STROKE	inj xone(3rd gen cepha),mezol	09.11.10	2	18	3 Early	E	12.11.10
23	390900	R	R	S	S	R	R	-	-	-	7		L.SIG THROMBOSIS	inj xone(3rd gen cepha) ,azithral	02.11.10	1	12	6 late	E	08.11.10
24	393378	I	R	R	S	R	-	-	-	NP	7		VHF WITH ME	inj.xone(3rd gen cepha),inj.piptaz	23.11.10	1	13	6 late	E	29.11.10
25	395187	-	-	-	-	-	S	-	Pos	-	7		CEREBRALMALARIA	inj.xone(3rd gen cepha),antimalarials	05.12.10	1	9	3 Early	E	08.12.10
26	395384	R	R	R	R	R	S	-	-	-	7		CEREBRALMALARIA	inj.xone(3rd gen cepha),antimalarials	07.12.10	1	6	3 Early	D	10.12.10
27	395189	S	R	R	S	R	S	-	-	-	7		MYASTHENIA GRAVIS	inj.fortum.(3rd gen cepha)	08.12.10	1	8	5 late	D	13.12.10

ANNEXURE IV - MASTER CHART

Sl. No.	IP NO.	Age (Years)	Sex	Date of admission	DM	HTN	COPD	Steoroids	Alcohol	Smoking	Enteral feeds	Temperature	TLC (/mm3)	Tracheal secretions	Chest X-ray	Blood culture	Penicillin	Oxacillin	Erythromycin	Clindamycin	Cefotaxime	Linezolid	Vancomycin	Cephalexin	Ciprofloxacin	Cotrimoxazole	Amoxyclav
28	396126	48	M	06.12.10	Y	N	N	N	N	Y	N	101.4	19,700	purulent	RT- U,M,LL , LT- U,LL	A.Species	-	-	-	-	R	-	-	-	R	R	R
29	396436	60	M	06.12.10	Y	N	N	Y	Y	Y	Y	101	22,000	purulent	RLC	A.Bau	-	-	-	-	-	-	-	-	R	R	-
30	397240	26	M	09.12.10	N	N	N	N	N	N	N	101	1400	purulent	Bl Br Pn	P. aeru	-	-	-	-	-	-	-	-	R	R	-
31	3977312	59	F	19.12.10.	N	Y	N	Y	N	N	Y	100.4	23,400	purulent	LT- U,LL	A.Bau	-	-	-	-	-	-	-	-	R	R	-
32	398331	75	M	27.12.10	N	N	Y	Y	Y	Y	N	100.6	16,000	purulent	RLC	A.Bau	-	-	-	-	-	-	-	-	R	R	-
33	397396	68	M	20.12.10	N	Y	N	N	N	Y	Y	101.2	15,900	purulent	RT - U,M LL , LT - U,LL	E Coli	-	-	-	-	-	-	-	-	R	R	-
34	398247	27	M	27.12.10	N	N	N	N	N	Y	N	101	17,100	purulent	RLC	A.Bau	-	-	-	-	-	-	-	-	R	R	-
35	398748	60	M	05.01.11	N	N	N	N	N	N	N	100.2	15,100	purulent	RLC	A.Bau	-	-	-	-	-	-	-	R	R	R	R
36	399266	25	F	03.01.11	N	N	N	Y	N	N	Y	100.8	33,300	purulent	Bl Br Pn	P. aeru	-	-	-	-	-	-	-	-	R	R	-
37	400749	48	F	14.01.11	Y	Y	N	N	N	N	N	101	14,000	purulent	Bl Br Pn	A.Bau	-	-	-	-	-	-	-	-	R	R	-
38	401809	49	F	15.01.11	N	Y	N	N	N	N	Y	100.4	11,800	purulent	RLC	P. aeru	-	-	-	-	-	-	-	-	R	R	-
39	402727	42	M	26.01.11	Y	N	N	N	Y	N	Y	101	13,500	purulent	RLC	A.Bau	-	-	-	-	-	-	-	-	R	R	-
40	402761	19	M	01.02.11	N	N	N	N	N	N	Y	100.4	18,100	purulent	RLC	P. aeru	-	-	-	-	-	-	-	-	R	R	-
41	404292	62	M	02.02.11	N	N	N	Y	Y	Y	N	100.2	15,200	purulent	Bl Br Pn	A.Bau	-	-	-	-	-	-	-	-	R	R	-
42	403790	18	M	09.02.11	N	N	N	N	N	N	N	101	24,400	purulent	RLC	P. aeru	-	-	-	-	-	-	-	-	R	R	-
43	361988	84	M	01.04.10	N	N	N	N	Y	N	N	100.4	13,500	purulent	Bl Br Pn	A.Bau	-	-	-	-	-	-	-	-	R	R	-
44	370941	50	M	16.06.10	Y	N	N	N	Y	N	N	100.4	10,500	purulent	Bl Br Pn	A.Bau	-	-	-	-	-	-	-	-	R	R	-
45	400884	49	M	15.01.11	N	N	N	N	N	N	Y	101	13,400	purulent	LT- U,LL	P. aeru	-	-	-	-	-	-	-	-	R	R	-
46	411755	40	F	08.04.11	N	N	N	N	N	N	N	101	12,800	purulent	RLC	P. aeru	-	-	-	-	-	-	-	-	R	R	-
47	425671	42	M	14.05.11	N	N	N	Y	N	Y	Y	101.2	15,000	purulent	RLC	Kleb	-	-	-	-	-	-	-	R	R	R	R
48	416689	25	M	09.05.11	N	N	N	N	N	N	N	100.8	13,000	purulent	Bl Br Pn	A.Bau	-	-	-	-	-	-	-	-	R	R	-
49	418932	66	M	20.05.11	Y	Y	N	N	Y	N	N	101	16,000	purulent	RT - U,M LL , LT - U,LL	MRSA	R	R	R	R	S	R	S	R	R	R	R
50	427273	53	M	24.04.11	N	N	N	N	Y	Y	N	100.2	12,000	purulent	Bl Br Pn	P. aeru	-	-	-	-	-	-	-	-	R	R	-
51	340001	64	M	21.05.11	N	N	N	N	N	N	N	100.4	12,200	purulent	Bl Br Pn	P. aeru	-	-	-	-	-	-	-	-	R	R	-
52	362126	30	M	26.5.11	N	N	N	N	N	Y	N	101	3700	purulent	LLC	A.Bau	-	-	-	-	-	-	-	-	R	R	-
53	362253	25	M	16.4.11	N	N	N	N	N	N	N	101.2	18,000	purulent	RLC	A.Bau	-	-	-	-	-	-	-	-	R	R	-

ANNEXURE IV - MASTER CHART

Sl. No.	IP NO.	Imipenem	Amikacin	Aztreonam	Pipercillin-tazobactam	Ceftazidime	Doxycycline	Meropenem	MRSA	MBL	CPI Score		Antibiotics	Date of Intubation	Intubation (No of times	Mech Ventilation (Days	Onset	Outcome	DOC
28	396126	R	R	R	R	R	R	R	-	-	7	ANT SEPTAL MI	inj xone(3rd gen cepha)	07.12.10	1	10	4 early	D	11.12.10
29	396436	R	R	S	S	R	-	-	-	P	7	ALD WITH STROKE	inj,xone(3rd gen cepha),mezol,piptaz	08.12.10	1	15	7 L	E	15.12.10
30	397240	R	R	R	R	R	S	-	-	-	7	OPP	inj.xone(3rd gen cephalosorin)	13.12.10	1	7	5 late	D	18.12.10
31	3977312	R	R	R	I	R	S	-	-	-	7	INTRACEREBRAL BLEED	inj.xone(3rd gen cephalosorin)	19.12.10	1	10	5 late	D	24.12.10
32	398331	S	S	R	S	R	-	-	-	NP	7	CCF	inj.xone(3rd gen cephalosorin)	27.12.10	2	15	4 early	E	31.12.10
33	397396	R	R	R	S	R	S	-	-	-	7	RT MCA INFARCT	inj.xone(3rd gen cephalosorin)	25.12.10	2	15	10 late	D	04.01.11
34	398247	R	R	R	S	R	S	-	-	-	7	VIRALENCHEPHALITIS	inj.piptaz	01.01.11	1	12	6 late	D	07.01.10
35	398748	R	S	S	S	R	-	-	-	-	7	OPP	inj.xone(3rd gen cephalosorin)	07.01.11	1	10	3 Early	D	10.01.11
36	399266	R	R	R	S	R	R	-	-	-	7	PP CVT	inj.xone(3rd gen cephalosorin)	03.01.11	1	17	11 late	E	14.01.11
37	400749	R	R	R	S	R	R	-	-	-	7	RT LL CELLULITIS	inj acuclav,clindamycin	14.01.11	1	15	4 early	E	18.01.11
38	401809	S	R	R	S	S	-	-	-	NP	7	LVF	inj.xone(3rd gen cephalosorin)	15.01.11	1	15	9 late	D	24.01.11
39	402727	R	R	R	S	R	S	-	-	-	7	HANGING	inj.xone(3rd gen cephalosorin)	26.01.11	3	15	7 late	E	02.02.11
40	402761	R	R	R	S	S	-	-	-	P	7	HANGING	inj.fortum.(3rd gen cepha)	01.02.11	1	10	4 early	D	05.02.11
41	404292	R	R	R	S	S	-	-	-	P	7	COPD	inj.levofloxacin(fluroquinolones	03.02.11	1	14	5 late	E	08.02.11
42	403790	R	R	R	S	R	S	-	-	-	7	OPP	inj.xone(3rd gen cepha), mezol	09.02.11	2	12	5 late	D	14.02.11
43	361988	R	R	R	S	S	-	-	-	NP	7	ALD WITH UGI BLEED	ing.piptaz,inj azom	10.04.10	1	10	5 late	E	15.04.10
44	370941	R	R	R	S	R	R	-	-	-	7	HE	inj,.potaz,azom	16.06.10	1	10	4 early	E	20.06.10
45	400884	S	R	R	S	R	-	-	-	NP	7	THYMOMA	inj.fortum.(3rd gen cepha)	16.01.11	1	10	5 late	D	19.01.11
46	411755	S	R	R	S	S	-	-	-	NP	7	OPP	inj.xone(3rd gen cepha),mezol	08.04.11	1	9	5 late	D	13.04.11
47	425671	S	R	R	S	I	-	-	-	-	7	LT MCA BLEED	inj.xone(3rd gen cephalosorin)	15.05.11	1	10	3 early	D	17.05.11
48	416689	R	R	R	R	R	S	-	-	-	7	CEREBRALMALARIA	inj.xone(3rd gen cepha),antimalarials	10.05.11	1	12	6 late	E	16.05.11
49	418932	-	-	-	-	-	S	-	Pos	-	7	CCF	inj.xone(3rd gen cephalosorin)	20.05.11	1	15	5 late	E	25.05.11
50	427273	R	R	R	S	S	-	-	-	P	7	HE	inj potaz,azom	25.04.11	1	11	6 late	E	01.05.11
51	340001	R	R	R	S	R	-	-	-	P	7	UROSEPSIS	inj.norflox(fluroquinolones	22.5.11	1	13	7 late	E	28.05.11
52	362126	R	R	R	S	R	S	-	-	-	7	ADENOCARCINOMA OF LUNG	inj piptaz	27.5.11	1	14	7 late	D	5.6.11
53	362253	R	R	R	R	R	S	-	-	-	7	OPP	inj.xone(3rd gen cepha),mezol	16.4.11	1	10	6 late	D	22.4.11

Annexures

Annexure IV

ANNEXURE IV – KEY TO MASTER MASTER CHART

3rd Gen Cepha	:	Third generation cephalopsorins
A. Baumannii	:	Acinetobacter baumannii
ALD	:	Alcoholic liver disease
Bl/BrPn	:	Bilateral broncho pneumonia
BUCCAL CA	:	Buccal carcinoma
C. frau	:	Citrobacter fraundii
CCF	:	Congestive cardiac failure
COPD	:	Chronic obstructive pulmonary disease
CPIS	:	Clinical pulmonary infection score
D	-	Discharge
DM	:	Diabetes mellitus
Doc	-	Date of collection of sample
E	-	Expiry
E.Coli	:	Escherichia coli
F	:	Female
GBS	:	Gullain barre' syndrome
HE	:	Hepatic encephalopathy
HTN	:	Hypertension
I	:	Intermediate
Inj. Azom	-	Injection Aztreonam
Inj. Piptaz	-	Injection piperacillin – Tazobactam
IP No.	:	In patient number
Kleb	:	Klebsiella pneumonia

L.Sig.Sinus thrombosis:		Lateral sigmoid sinus thrombosis
LLC	:	Left lobar consolidation
Lt – U, LL	:	Let upper and lower lobe consolidation
LT MCI Bleed	:	Left middle cerebral artery bleed
LVF	:	Left ventricular failure
M	:	Male
M. Encephalopathy	:	Metabolic encephalopathy
MBL – P	:	Metallo beta lactamase producing
MBL	-	Metallo beta lactamase
MBL-NP	:	Metallo beta lactamase not producing
MI	:	Myocardial infarction
ML	:	Malaria
MRSA	:	Methicillin resistant staphylococcus aurous
N	:	No
Neg	:	Negative
OPP	:	Organo phosphorous poisoning
P. aeru	:	Pseudomonas aeruginosa
Pos	:	Positive
PPCVT	:	Post partum cortical venous thrombosis
R	:	Resistant
RLC	:	Right lobar consolidation
Rt MCA Infarct	:	Right middle cerebral artery infarct
RT, U, M, Cl	:	Right upper, middle, lower lobe consolidation
S	:	Sensitive

Sl. No.	:	Serial number
TLC	:	Total leukocyte count
UGI bleed	:	Upper gastro intestinal bleed
VHF with ME	:	Viral haemorrhagic fever with metabolic Encephalopathy
Y	:	Yes