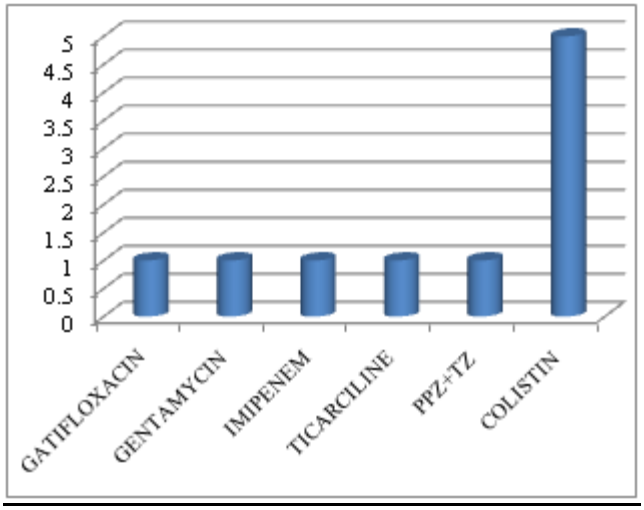
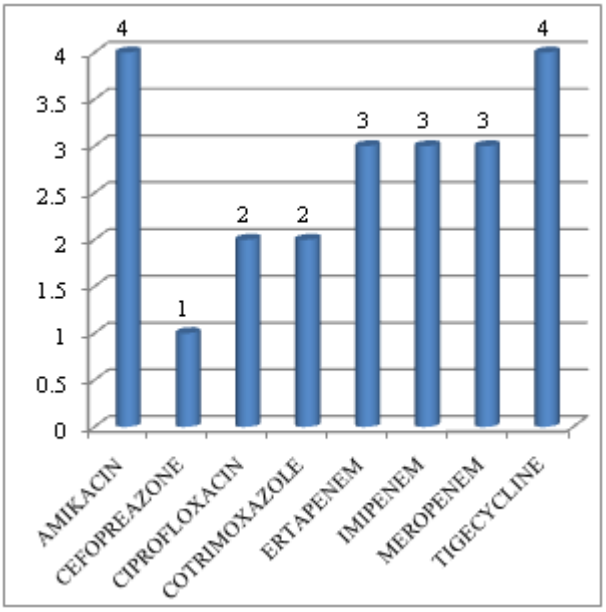
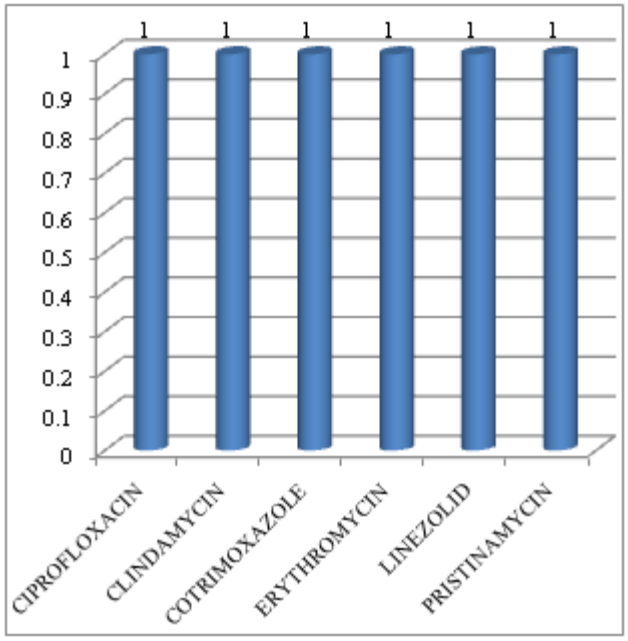


Graph 6: E. Sensitivity Of P. Aeruginosa



Graph 6: f. Sensitivity of E. Coli



Graph 9: E. Sensitivity of Coagulase Positive S. Aureus

From the above tables, all the organisms isolated were resistant to all antibiotics that are being routinely used in ICU setting. The acetinobacter isolates were most sensitive to tigecycline and imipenem. The isolates of Klebsiella were sensitive to tigecycline, colistin and imipenem. The isolates of pseudomonas were sensitive to tigecycline and imipenem. The isolates of Escherichia coli were sensitive to amikacin and tigecycline. The coagulase positive staphylococcus was sensitive to ciprofloxacin and clindamycin.

5. Discussion

The incidence of VAP in our study was 34.8%.this correlates with other studies in which the incidence of VAP was 15.5 to 47%, depending on the diagnostic criteria used.[48, 49, 50, and 51] There was no statistically significant association between the age of the patient and development of VAP, indicating that age is neither predisposing nor protective factor for the development of VAP. There was no statistically significant association between the gender of the patient and development of VAP, and both males and females are equally predisposed to VAP.[52]

Table 9: Drug Sensitivity Patterns

	Fagon and colleagues, 1984[50]	*Torres and colleagues,1990*[48]	*Panwar and colleagues,2005*[51]	*Gupta and colleagues, 2010*	*Our study*
Incidence of VAP(%)	27.5	24	47	28.04	34.8
Mortality rate (%)	53	33	37	32.71	76.6
Technique used	Protected specimen brush	Protected specimen brush, BAL	Tracheal aspirate	Tracheal aspirate	Tracheal aspirate
P.aeruginosa	16(31%)	7(28%)	11(46%)	9(30%)	5(16.66%)
S.aureus	17(33%)	5(20%)	6(25%)	8(26.67%)	-
Acinetobacter	8(15%)	6(24%)	2(8%)	6(20%)	20(66.66%)
K.pneumoniae	2(4%)	3(12%)	7(29%)	7(23.33%)	11(36.66%)
Proteus	8(15%)	-	3(13%)	-	-
E.coli	4(8%)	3(12%)	3(13%)	-	5(16.66%)
S. pneumoniae	3(6%)	1(4%)	-	1(3.33%)	-
Coagulase positive staph. Aureus	-	-	-	-	1(3.33%)

The most common organism isolated was Acinetobacter baumannii which was the common pathogen in study by Arindam Dey and Indira Bairy.[54] Out of 20 isolates, 14 were from patients with early onset VAP and 6 from late onset VAP.The next common organism was Klebsiella pneumoniae with total of 11isolates.Out of these 11 isolates, 7 isolates were in early onset VAP, followed by E.coli 5 isolates and pseudomonas with 5 isolates. The least common was of Coagulase positive Staphylococcus aureus with only 1. There is no significant association between the microbiological patterns of VAP in our hospital with duration of stay.

Analysis of antibiotic sensitivity pattern suggests that these organisms were highly resistant to commonly used antibiotics in our hospital. All 20(100%) isolates of Acinetobacter were sensitive to tigecycline, 11(55%) isolates were sensitive to imipenem 4(20%) to colistin. VAP due to multidrug resistant acetinobacter sensitive to tigecycline is common in our setting.[35,38,39,40,46,47] Out of 11 isolates of Klebsiella all 11(100%) were sensitive to tigecycline,7(63.63%) were sensitive to imipenem and 5(45.45%) to amikacin and 2 (18.18%) to ciprofloxacin and piperacillin and tazobactam, suggesting a high prevalence of extended spectrum beta-lactamase(ESBL) producing organisms in our setting.All the 5(100%) isolates of Pseudomonas aeruginosa were sensitive to colistin. 4(80%) out of 5 isolates E.coli was found sensitive to tigecycline and amikacin.3 isolates(60%) were sensitive to carbapenems This observation suggests that the organisms isolated in etiology of VAP in our hospital were resistant to commonly used antibiotics like fluoroquinolones, cephalosporins and aminoglycosides but showed variable sensitivity to tigecycline,colistin and carbapenems. Mortality of VAP group was 76.6% which is very high. A similar high mortality was found in other studies.[53]

6. Conclusions and Summary

Thus , we conclude that most of the VAP cases in our setting were early onset VAP & majority of these are caused by highly resistant strains.VAP due to multidrug resistant acetinobacter sensitive to tigecycline is common in our setting. And local epidemiological data should be connected at all centres, as the information can help in guiding the initial empirical antibiotic therapy, which would be more rationale and help in decreasing mortality and morbidity. An effective empirical antibiotic therapy would also help in preventing development of more resistant strains. CLINICAL UTILITY: To choose the most appropriate empirical antibiotics

References

[1] Singh N, Rogers P, Atwood CW, et al. Short-Course Empiric Antibiotic Therapy for Patients with Pulmonary Infiltrates in the Intensive Care Unit. A Proposed Solution for Indiscriminate Antibiotic Prescription. Am J Respir Crit Care Med., 2000; 162(2 Pt 1): 505-11.
[2] Namias, samiian L, Nino D, Shirazi E, O'Neill K, Kett DH.Incidence and susceptibility of pathogenic bacteria vary between intensive care units within a single hospital: implications for empiric antibiotic strategies.J Trauma 2000; 49:638-45.
[3] Rello J,Quintana E,Ausina V,Castella J,Luquin M,Net A,Prats G:Incidence,etiology,and outcome of nosocomial pneumonia in mechanically ventilated patients.
[4] Estes RJ, Meduri GU. The pathogenesis of ventilator-associated pneumonia: I. Mechanisms of bacterial transcolonization and airway inoculation. Intensive Care Med 1995; 21(4):365–383.
[5] de la Torre FJ, Pont T, Ferrer A, Rossello J, Palomar M, Planas M. Pattern of tracheal colonization during mechanical ventilation. Am J Respir Crit Care Med 1995;152(3):1028–1033.
[6] Niederman MS, Mantovani R, Schoch P, Papas J, Fein AM. Patterns and routes of tracheobronchial colonization in mechanically ventilated patients. The role of nutritional status in colonization of the lower airway by *Pseudomonas* species. Chest 1989; 95(1):155–161.
[7] Zeiher BG, Hornick DB. Pathogenesis of respiratory infections and host defenses. Curr Opin Pulm Med 1996;2(3):166–173.
[8] Koerner RJ. Contribution of endotracheal tubes to the pathogenesis of ventilator-associated pneumonia. J Hosp Infect 1997;35(2):83–89.
[9] Valles J, Artigas A, Rello J, Bonsoms N, Fontanals D, Blanch L, etal. Continuous aspiration of subglottic secretions in preventing ventilator-associated pneumonia. Ann Intern Med 1995; 122(3):179–186.
[10] Mahul P, Auboyer C, Jospe R, Ros A, Guerin C, el Khouri Z, et al. Prevention of nosocomial pneumonia in intubated patients: respective role of mechanical subglottic secretions drainage and stress ulcer prophylaxis. Intensive Care Med 1992; 18(1):20–25.
[11] Kyle UG, Genton L, Heidegger CP, et al. Hospitalized mechanically ventilated patients are at higher risk of enteral underfeeding than non-ventilated patients. Clin Nutr. 2006; 25 (5):727 - 735.
[12] Shorr AF, Duh MS, Kelly KM, Kollef MH. Red blood cell transfusion and ventilator-associated pneumonia: A potential link? Crit Care Med 2004; 32: 666-674.
[13] Zur KBMandell DLGordon REHolzman IRothschild MA Electron microscopic analysis of biofilm on endotracheal tubes removed from intubated neonates. *Otolaryngol Head Neck Surg* 2004; 130407- 414.
[14] Protera C forging a link beween biofilms and diseases.Science1999;2831837-1839
[15] Stewart PS Costerton JW Antibiotic resistance of bacteria in biofilms.Lancet 2001; 358135-138.
[16] Fabregas N,Ewig S,Torres A,EL-Ebiary M,Ramirez J,de La Bellacasa JP,Bauer T,Cabello H:Clinical diagnosis of ventilator-associated pneumonia.
[17] Marquette CH, Copin MC, Wallet F et al.Diagnostic tests for pneumonia in ventilated patients: prospective evaluation of diagnostic accuracy using histology as a diagnostic gold standard. Am J Respir Crit Care Med 1995; 151:1878-88.
[18] Marquette CH, Georges H, Wallet F, et al. Diagnostic efficiency of endotracheal aspirates with quantitative bacterial cultures in intubated patients with suspected pneumonia: comparison with the protected specimen brush. Am Rev Respir Dis1993; 148:138-44.

[19] Torres A, Martos A, Puig de la Bellacasa J, et al Specificity of endotracheal aspiration, protected specimen brush, and bronchoalveolar lavage in mechanically ventilated patients. Am Rev Respir Dis 1993; 147:952-7.
[20] Fagon JY,Chastre J,Wolff M,et al.Invasive and non-invasive strategies for management of suspected ventilator-associated pneumonia: a randomized trial. Ann Intern Med 2000; 132:621-30.
[21] Souweine B, Veber B, Bedos JP, et al. Diagnostic accuracy of protected specimen brush and bronchoalveolar lavage in nosocomial pneumonia: impact of previous antimicrobial treatments. Crit Care Med 1998; 26:236-44.
[22] Fujitani S, Yu VL Diagnosis of ventilator-associated pneumonia: focus on non bronchoscopic techniques (non bronchoscopic bronchoalveolar lavage including mini-BAL, blinded protected specimen brush, and blinded bronchial sampling) and endotracheal aspirates. J Intensive Care Med 2006; 21:17-21.
[23] Torres A, Puig de la Bellacasa J, Rodriguez Roisin R, Jimenez de Anta MT, Agusti-Vidal A. Diagnostic value of telescoping plugged catheters in mechanically ventilated patients with bacterial pneumonia using the Metras catheter. Am Rev Respir Dis1988; 138:117-20.
[24] Fartoukh M, Maitre B, Honore S, Cerf C, Zahar JR, Brun-Buisson C (2003) Diagnosing pneumonia during mechanical ventilation: the Clinical Pulmonary Infection Score revisited. Am J Respir Crit Care Med 168:173–179
[25] Luyt CE, Chastre J, Fagon JY. Value of the clinical pulmonary infection score for the identification and management of ventilator-associated pneumonia. *Intensive Care Med.* 30(5), 844–852(2004).
[26] Zilberberg MD, Shorr AF. Ventilator-associated pneumonia: the clinical pulmonary infection score as a surrogate for diagnostics and outcome. *Clin. Infect. Dis.* 51 (Suppl. 1), S131–S135 (2010).
[27] Alvarez-Lerma F.Modifications of empiric antibiotic treatment in patients with pneumonia acquired in the intensive care unit:ICU-Acquired Pneumonia Study Group. Intensive Care Med 1996;22:387-394.
[28] Heyland DK,Cook DJ,Griffith L et al.The attributable mortality and morbidity of ventilator-associated pneumonia in the critically ill patient.AMJ Respir Crit Care Med 1999;159:1249-1256.
[29] Trouillet JL,Chastre J,Vuagnat A,et al.Ventilator associated pneumonia caused by potentially drug resistant bacteria.AM J Respir Crit Care Med 1998;157:531-539.
[30] Kollef MH.The Prevention of Ventilator associated pneumonia.N Engl J Med 1999; 340:627-634.
[31] Coffin, S, et al. Strategies to Prevent Ventilator-Associated Pneumonia in Acute Care Hospitals. Infect Control Hosp Epidemiol 2008; 29:S31-S40.
[32] Tigecycline for the treatment of multidrug-resistant(including Carbapenem-resistant) Acinetobacter infections:a review of the scientific evidence.J antimicrob chemother .july 2008 62:145-55
[33] Acinetobacter baumanii:Epidemiology,Antimicrobial Resistance,and treatment options.Clinical Infectious Diseases.April 2008 46:8 1254-1263
[34] Wates KB,Duffy LB,Dowzicky MJ.Antimicrobial susceptibility among pathogens collected from hospitalized patients in the United States and in vitro activity of tigecycline,a new glycylcycline antimicrobial.Antimicrob Agents Chemother.2006 oct;50(10):3479-84
[35] Drakulovic MB, Torres A, Bauer TT, Nicolas JM, Nogué S, Ferrer M: Supine body position as a risk factor for nosocomial pneumonia in mechanically ventilated patients: a randomised trial. *Lancet* 1999, 354:1851-1858.
[36] Li Bassi G, Torres A: Ventilator-associated pneumonia: role of positioning.*Curr Opin Crit Care* 2011, 17:57-63.
[37] Muscedere J, Rewa O, McKechnie K, Jiang X, Laporta D, Heyland DK: Subglottic secretion drainage for the prevention of ventilator-associated pneumonia: a systematic review and meta-analysis. *Crit Care Med* 2011, 39:1985-1991.
[38] Griffiths J, Barber VS, Morgan L, Young JD: Systematic review and meta-analysis of studies of the timing of tracheostomy in adult patients undergoing artificial ventilation.*BMJ* 2005, 330:1243.
[39] Terragni PP, Antonelli M, Fumagalli R, *et al.*: **Early vs late tracheotomy for prevention of pneumonia in mechanically ventilated adult ICU patients: a randomized controlled trial***JAMA* 2010, **303:**1483-1489.
[40] Baraibar J et al.Risk factors for infection for Acinetobacter baumanii in intubatedpatients with nosocomial pneumonia.Chest.1997 Oct;112(4):1050-4.
[41] Husni RN,Goldstein LS et al.Risk factors for an outbreak of multi-drug-resistant Acinetobacter nosocomial pneumonia among intubated patients.Chest.1999 May;115(5):1378-82.
[42] Torres A,Puig de la Bellacasa J,Xaubet A,Gonzalez J,Rodriguez-Roisin R,Jimenez de Anta MT,et al.Diagnostic value of quantitative cultures of bronchoalveolar lavage and telescoping plugged catheters in mechanically ventilated patients with bacterial pneumonia.Am Rev Respir Dis 1989;140:306-10
[43] Kollef MH.Ventilator-associated pneumonia:A multivariate analysis.JAMA 1993;270:1965-70.
[44] Fagon JY,Chastre J,Domart Y,Trouillet JL,Pierre J,Darne C,et al.Nosocomial pneumonia in patients receiving continuous mechanical ventilation:Prospective analysis of 52 episodes with use of protected specimen brush and quantitative culture techniques.Am Rev Respir Dis 1989;139:884
[45] Panwar R,Vidya SN,Alka KD.Incidence,clinical outcome and risk stratification of ventilator-associated pneumonia:A prospective cohort study.Indian J Crit Care Med 2005;9:211-6.
[46] Apostolopoulou E,Bakakos P,Katostaras T,Gregorakos L.Incidence and risk factors for Ventilator- associated pneumonia in 4 multidisciplinary intensive care units in Athens,Greece.Respir Care 2003;48:681-8.
[47] Pennigton JE.nosocomial respiratory infection. In : mandell GL,douglas RG Jr,bennet JE,editors. Principles and practice of infectious disease. St.louis,MO:Churchill livingstone;1990.p.2199-2205.
[48] Arindam Dey,Indira Bairy.Incidence of multidrug-resistant organisms causing ventilator-associated

pneumonia in a tertiary care hospital:A nine months prospective study.Ann Thorac Med.2007 Apr-Jun;2(2):52-57.

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