

## BÖLÜM

# 5

# VENTİLATÖR İLİŞKİLİ PNÖMONİ

Aysegül İLBAN<sup>1</sup>

## GİRİŞ

Ventilatör ilişkili pnömoni (VİP), mekanik ventilatör desteği alan hastalarda en sık olarak görülen hastane kaynaklı enfeksiyonlardan biridir ve yoğunbakım ünitelerinde kalış süresini, mortalite oranını, antibiyotik kullanımını ve maliyetleri ciddi oranda yükseltmektedir. VIP endotrakeal entübasyonu takip eden 48 saat sonrasında ortaya çıkan yeni veya progresif bir infiltrat varlığı gösteren sistemik enfeksiyon belirtileri ile karakterize hastane kaynaklı pnömonidir. Tanı genel tıbbi muayene, radyolojik tetkik ve solunum sistemi sekresyonlarının mikrobiyolojik incelemesi ile konulmaktadır. VIP hastane kaynaklı pnömoni vakalarının büyük bir kısmından sorumludur (1). VIP'in mekanik ventilatör desteği alan tüm hastaların % 9-27'sinde ortaya çıktıgı tahmin edilmektedir (2). Türkiyede yapılan çok merkezli bir çalışmada yoğunbakım ünitelerinde 1000 invaziv alet kullanımına göre mekanik ventilatör kullanımı %63 iken bu vakaların %32,6'sında VIP oluştuğu tespit edilmiştir (3).

VIP'e bağlı gelişen mortalite oranı %24 ile %76 arasında değişiklik göstermektedir (4). VIP'e bağlı gelişen mortalitedeki bu farklılık yoğunba-

kım hasta popülasyonlarındaki farka, eşlik eden sekonder etmenlere kısmen de ilk iki gün içerisinde uygulanan ampirik tedavinin uygunluğuna bağlı olarak değişiklik göstermektedir. Ayrıca VIP'e neden olan mikroorganizmada mortaliteyi etkilemektedir özellikle *Pseudomonas aeruginosa*, *Acinetobacter* spp. ve *Stenotrophomonas maltophilia* bağlı oluşan enfeksiyonlarda mortalite yükselmektedir (5).

VIP'i başlangıç zamanına bağlı olarak iki tür ayırmak mümkündür. Erken dönem VIP endotrakeal entübasyonu takip eden ilk dört gün içerisinde başlar ve çoğunlukla antibiyotik direnci düşük olan bakterilerden kaynaklanmaktadır. Geç VIP ise dördüncü günden sonra ortaya çıkmakta ve çoğunlukla multidrug resistant (MDR) patojenlere bağlı olarak gelişmektedir (2).

Mekanik ventilasyonu takip eden 48 saat sonrası vücut immun sistemini geçmeyi başaran patojen pulmoner parankime invaze olur. Bakteri inokülasyonu steril olan alt hava yollarına, solunum sistemi sekresyonlarının aspirasyonu, uygulanan invaziv işlemlere bağlı oluşan kontaminasyonlar ya da sindirim sistemi kolonizasyonlarına bağlı olarak gelişmektedir. VIP'de uzamiş entü-

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konuya ilgili daha fazla saha çalışmasına ihtiyaç duyulmaktadır (64).

## Probiyotikler

Probiyotikler orofarenks ve mide de VIP'e neden olan patojen mikroorganizmalar ile rekabet içerisinde girmektedir. Geliştilmiş mikrobiyal dengenin VIP insidansını azalttığı, ancak yoğun bakım kalış süresi, mortalite oranları ve ventilasyon süresini değiştirmediği gösterilmektedir (68).

## KAYNAKLAR

1. American Thoracic Society; Infectious Diseases Society of America. Guidelines for the management of adults with hospital-acquired,ventilator-associated, and healthcare-associated pneumonia. *Am J Respir Crit Care Med.* 2005;171:388-416.
2. Chastre J, Fagon JY. State of the art: ventilator-associated pneumonia. *Am J Respir Crit Care Med.* 2002;165:867-903.
3. Leblebicioğlu H, Rosenthal VD, Arikhan ÖA, et al. Device-associated hospital acquired infection rates in Turkish intensive care units. Findings of the International Nosocomial Infection Control Consortium (INCC). *J Hosp Infect.* 2007;65:251-257.
4. Choudhuri AH. Ventilator-Associated Pneumonia: When to hold the breath? *Int J Crit Illn Inj Sci.* 2013;3:169-74.
5. Kollef MH, Silver P, Murphy DM, et al. The effect of late-onset ventilator-associated pneumonia in determining patient mortality. *Chest.* 1995;108:1655-1662.
6. Coffin SE, Klompas M, Classen D, et al. Strategies to prevent ventilator-associated pneumonia in acute care hospitals. *Infect Control Hosp Epidemiol.* 2008;29:31-40.
7. Vincent JL, Sakr Y, Sprung CL et al. Sepsis in European intensive care units: results of the SOAP study. *Crit Care Med.* 2006;34:344-53.
8. Dullenkopf A, Gerber A, Weiss M. Fluid leakage past tracheal tube cuffs: evaluation of the new Microcuff endotracheal tube. *Intensive Care Med.* 2003;29:1849-1853.
9. Konrad F, Schreiber T, Brecht-Kraus D, et al. Mucociliary transport in ICU patients. *Chest.* 1994;105:237-241.
10. Li Bassi G, Zanella A, Cressoni M, et al. Following tracheal intubation, mucus flow is reversed in the semirecumbent position: possible role in the pathogenesis of ventilator-associated pneumonia. *Crit Care Med.* 2008;36:518-525.
11. Prost N, Roux D, Dreyfuss D, et al. Alveolar edema dispersion and alveolar protein permeability during high volume ventilation: effect of positive end-expiratory pressure. *Intensive Care Med.* 2007;33:711-717.
12. Mietto C, Pinciroli R, Patel N, et al. Ventilator associated pneumonia: evolving definitions and preventive strategies. *Respir Care.* 2013;58:990-1007.
13. Feldman C, Kassel M, Cantrell J, et al. The presence and sequence of endotracheal tube colonization in patients undergoing mechanical ventilation. *Eur Respir J.* 1999;13:546-551.
14. Hall-Stoodley L, Stoodley P. Evolving concepts in biofilm infections. *Cell Microbiol.* 2009;11:1034-1043.
15. Inglis TJ, Millar MR, Jones JG, et al. Tracheal tube biofilm as a source of bacterial colonization of the lung. *J Clin Microbiol.* 1989;27:2014-2018.
16. Hunter JD. Ventilator associated pneumonia. *BMJ.* 2012;344:e3325.
17. Rello J, Ausina V, Castella J, et al. Nosocomial respiratory tract infections in multiple trauma patients. Influence of level of consciousness with implications for therapy. *Chest.* 1992;102:525-9.
18. Ewig S, Torres A, El-Ebiary M, et al. Bacterial colonization patterns in mechanically ventilated patients with traumatic and medical head injury. Incidence, risk factors, and association with ventilator-associated pneumonia. *Am J Respir Crit Care Med.* 1999;159:188-98.
19. Garibaldi RA, Britt MR, Coleman ML, et al. Risk factors for postoperative pneumonia. *Am J Med.* 1981;70:677-80.
20. Grobmyer SR, Maniscalco SP, Purdue GF, et al. Alcohol, drug intoxication, or both at the time of burn injury as a predictor of complications and mortality in hospitalized patients with burns. *J Burn Care Rehabil.* 1996;17:532-9.
21. Chastre J, Trouillet JL, Vuagnat A, et al. Nosocomial pneumonia in patients with acute respiratory distress syndrome. *Am J Respir Crit Care Med.* 1998;157:1165-72.
22. Markowicz P, Wolff M, Djedäni K, et al. Multi-center prospective study of ventilator-associated pneumonia during acute respiratory distress syndrome. Incidence, prognosis, and risk factors. ARDS Study Group. *Am J Respir Crit Care Med.*

- 2000;161:1942–8.
23. Rello J, Torres A, Ricart M, et al. Ventilator-associated pneumonia by *Staphylococcus aureus*. Comparison of methicillin-resistant and methicillin-sensitive episodes. *Am J Respir Crit Care Med*. 1994;150:1545–9.
  24. Bonten MJ, Gaillard CA, van der Geest S, et al. The role of intragastric acidity and stress ulcer prophylaxis on colonization and infection in mechanically ventilated ICU patients. A stratified, randomized, double-blind study of sucralfate versus antacids. *Am J Respir Crit Care Med*. 1995;152:1825–34.
  25. Sottile FD, Marrie TJ, Prough DS, et al. Nosocomial pulmonary infection: possible etiologic significance of bacterial adhesion to endotracheal tubes. *Crit Care Med*. 1986;14:265–70.
  26. Ibrahim EH, Ward S, Sherman G, et al. A comparative analysis of patients with early-onset vs late-onset nosocomial pneumonia in the ICU setting. *Chest*. 2000;117:1434–42.
  27. Prat G, Renault A, Tonnelier JM, et al. Influence of the humidification device during acute respiratory distress syndrome. *Intensive Care Med*. 2003;29:2211–5.
  28. Kearns PJ, Chin D, Mueller L, et al. The incidence of ventilator-associated pneumonia and success in nutrient delivery with gastric versus small intestinal feeding: a randomized clinical trial. *Crit Care Med*. 2000;28:1742–6.
  29. Kostadima E, Kaditis AG, Alexopoulos EI, et al. Early gastrostomy reduces the rate of ventilator-associated pneumonia in stroke or head injury patients. *Eur Respir J*. 2005;26:106–11.
  30. Pelosi P, Brazzi L, Gattinoni L. Prone position in acute respiratory distress syndrome. *Eur Respir J*. 2002;20:1017–28.
  31. Panigada M, Berra L, Greco G, et al. Bacterial colonization of the respiratory tract following tracheal intubation-effect of gravity: an experimental study. *Crit Care Med*. 2003;31:729–37.
  32. Holzapfel L, Chevret S, Madinier G, et al. Influence of long-term oro- or nasotracheal intubation on nosocomial maxillary sinusitis and pneumonia: results of a prospective, randomized, clinical trial. *Crit Care Med*. 1993;21:1132–8.
  33. ACourt CH, Garrard CS, Crook D, et al. Microbiological lung surveillance in mechanically ventilated patients, using non-directed bronchial lavage and quantitative culture. *Q J Med*. 1993;86:635–48.
  34. Skrupky LP, McConnell K, Dallas J, et al. A comparison of ventilator-associated pneumonia rates as identified according to the National Healthcare Safety Network and American College of Chest Physicians criteria. *Crit Care Med*. 2012;40:281–284.
  35. Fabregas N, Ewig S, Torres A, et al. Clinical diagnosis of ventilator associated pneumonia revisited: comparative validation using immediate post-mortem lung biopsies. *Thorax*. 1999;54:867–873.
  36. Luna CM, Blanzaco D, Niederman MS, et al. Resolution of ventilator-associated pneumonia: prospective evaluation of the clinical pulmonary infection score as an early clinical predictor of outcome. *Crit Care Med*. 2003;31:676–682.
  37. Chollet Martin S, Montravers P, Gibert C, et al. Subpopulation of hyperresponsive polymorphonuclear neutrophils in patients with adult respiratory distress syndrome. Role of cytokine production. *Am Rev Respir Dis*. 1992;146:990–996.
  38. Bell RC, Coalson JJ, Smith JD, et al. Multiple organ system failure and infection in adult respiratory distress syndrome. *Ann Intern Med*. 1983;99:293–298.
  39. Nseir S, Di Pompeo C, Pronnier P, et al. Nosocomial tracheobronchitis in mechanically ventilated patients: incidence, aetiology and outcome. *Eur Respir J*. 2002;20:1483–1489.
  40. Butler KL, Sinclair KE, Henderson VJ, et al. The chest radiograph in critically ill surgical patients is inaccurate in predicting ventilator-associated pneumonia. *Am Surg*. 1999;65:805–810.
  41. Wunderink RG, Woldenberg LS, Zeiss J, et al. The radiologic diagnosis of autopsy-proven ventilator associated pneumonia. *Chest* 1992;101:458–463.
  42. Luna CM, Videla A, Mattera J, et al. Blood cultures have limited value in predicting severity of illness and as a diagnostic tool in ventilator-associated pneumonia. *Chest*. 1999;116:1075–1084.
  43. du Moulin GC, Paterson DG, Hedley-Whyte J, et al. Aspiration of gastric bacteria in antacid-treated patients: a frequent cause of postoperative colonization of the airway. *Lancet*. 1982;101:242–245.
  44. Hill JD, Ratliff JL, Parrott JC, et al. Pulmonary pathology in acute respiratory insufficiency: lung biopsy as a diagnostic tool. *J Thoracic Cardiovasc Surg*. 1976;71:64–71.
  45. Michel F, Franceschini B, Berger P, et al. Early antibiotic treatment for BAL-confirmed ventilator-associated pneumonia: a role for routine endotracheal aspirate cultures. *Chest*. 2005;127:589–597.
  46. Blot F, Raynard B, Chachaty E, et al. Value of gram

- stain examination of lower respiratory tract secretions for early diagnosis of nosocomial pneumonia. *Am J Respir Crit Care Med.* 2000;162:1731–1737
47. Torres A, Ewig S. Diagnosing ventilator-associated pneumonia. *N Engl J Med.* 2004;350:433–435.
  48. Sterling TR, Ho EJ, Brehm WT, et al. Diagnosis and treatment of ventilator-associated pneumonia—impact on survival. A decision analysis. *Chest.* 1996;110:1025–1034.
  49. Meduri GU, Mauldin GL, Wunderink RG, et al. Causes of fever and pulmonary densities in patients with clinical manifestations of ventilator-associated pneumonia. *Chest.* 1994;106:221–235.
  50. Michaud S, Suzuki S, Harbarth S. Effect of design-related bias in studies of diagnostic tests for ventilator-associated pneumonia. *Am J Respir Crit Care Med.* 2002;166:1320–1325.
  51. Gallego M, Rello J. Diagnostic testing for ventilator-associated pneumonia. *Clin Chest Med.* 1999; 20:671–679.
  52. 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;151:1878–1888.
  53. Baker AM, Bowton DL, Haponik EF. Decision making in nosocomial pneumonia. An analytic approach to the interpretation of quantitative bronchoscopic cultures. *Chest.* 1995;107:85–95.
  54. Clinical Infectious Diseases, Management of Adults With Hospital-acquired and Ventilator-associated Pneumonia: Clinical Practice Guidelines by the Infectious Diseases Society of America and the American Thoracic Society. *CID.* 2016;63.
  55. Mart in-Lloches I, Deja M, Koulenti D, et al. Potentially resistant microorganisms in intubated patients with hospital-acquired pneumonia: the interaction of ecology, shock and risk factors. *Intensive Care Med.* 2013;39:672–681.
  56. Pasquale TR, Jabrocki B, Salstrom SJ, et al. Emergence of methicillin-resistant *Staphylococcus aureus* USA300 genotype as a major cause of late-onset nosocomial pneumonia in intensive care patients in the USA. *Int J Infect Dis.* 2013;17:398–403.
  57. Dimopoulos G, Poulakou G, Pneumatikos IA, et al. Short- versus long-duration antibiotic regimens for ventilator-associated pneumonia: a systematic review and meta-analysis. *Chest.* 2013;144:1759–1767.
  58. Swoboda SM, Dixon T, Lipsett PA. Can the clinical pulmonary infection score impact ICU antibiotic days? *Surg Infect (Larchmt).* 2006;7:331–339.
  59. Morris AC, Hay AW, Swann DG et al. Reducing ventilator-associated pneumonia in intensive care: impact of implementing a care bundle. *Crit Care Med.* 2011;39:2218–24.
  60. Rello J, Alfonso E, Lisboa T, et al. A care bundle approach for prevention of ventilator-associated pneumonia. *Clin Microbiol Infect.* 2013;19:363–9.
  61. Gunasekera P, Gratrix A. Ventilator-associated pneumonia. *BJA Education.* 2016;16:198–202.
  62. Nseir S, Zerimech F, Fournier C, et al. Continuous control of tracheal cuff pressure and microaspiration of gastric contents in critically ill patients. *Am J Respir Crit Care Med.* 2011;184:1041–7.
  63. Muscedere J, Rewa O, McKechnie K, et al. Subglottic secretion drainage for the prevention of ventilator-associated pneumonia: a systematic review and meta-analysis. *Crit Care Med.* 2011;39:1985–91.
  64. Coppadoro A, Bittner E, Berra L. Novel preventive strategies for ventilator-associated pneumonia. *Crit Care.* 2012;16:210.
  65. Kollef MH, Afessa B, Anzueto A, et al. Silver-coated endotracheal tubes and incidence of ventilator-associated pneumonia: the NASCENT randomized trial. *J Am Med Assoc.* 2008;300:805–13.
  66. Adair CG, Gorman SP, Byers LM, et al. Eradication of endotracheal tube biofilm by nebulised gentamicin. *Intensive Care Med.* 2002;28:426–31.
  67. Delaney A, Gray H, Laupland KB, et al. Kinetic bed therapy to prevent nosocomial pneumonia in mechanically ventilated patients: a systematic review and meta-analysis. *Crit Care.* 2006;10:R70.
  68. Liu K, Zhu Y, Zhang J, et al. Probiotics' effects on the incidence of nosocomial pneumonia in critically ill patients: a systematic review and meta-analysis. *Crit Care.* 2012;16:R109.