Chapter 30
Management of Pneumonia

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Learning Objectives
1. Differentiate between types of pneumonia and management strategies.
2. Describe the basic microbiology of pneumonias.
3. Develop a framework for treating pneumonia based on objectives 1 and 2.

Clinical Vignette: A 65-year-old man presents to the ED with 2 days of shortness of breath, productive cough, malaise, and subjective fevers. He is febrile with a temperature of 38.7 °C, his respiratory rate is 18, his SpO2 on room air is 94%, his HR is 95, and his blood pressure is 127/78. He has rhonchi and bronchial breath sounds over his left lower lung field. His CXR shows a left lower lobe infiltrate. You diagnose him with pneumonia.

A. **Based on his clinical presentation, in combination with his diagnostic chest x-ray, you diagnose him with community-acquired pneumonia (CAP). How do we define CAP?**

Write down the headings "CAP," "hospital acquired pneumonia (HAP)," and "Ventilator associated pneumonia (VAP),"—add the definition of CAP as shown in Fig. 30.1.

Teaching point
- CAP is an infection of the pulmonary parenchyma that occurred in a patient living outside of the healthcare setting.

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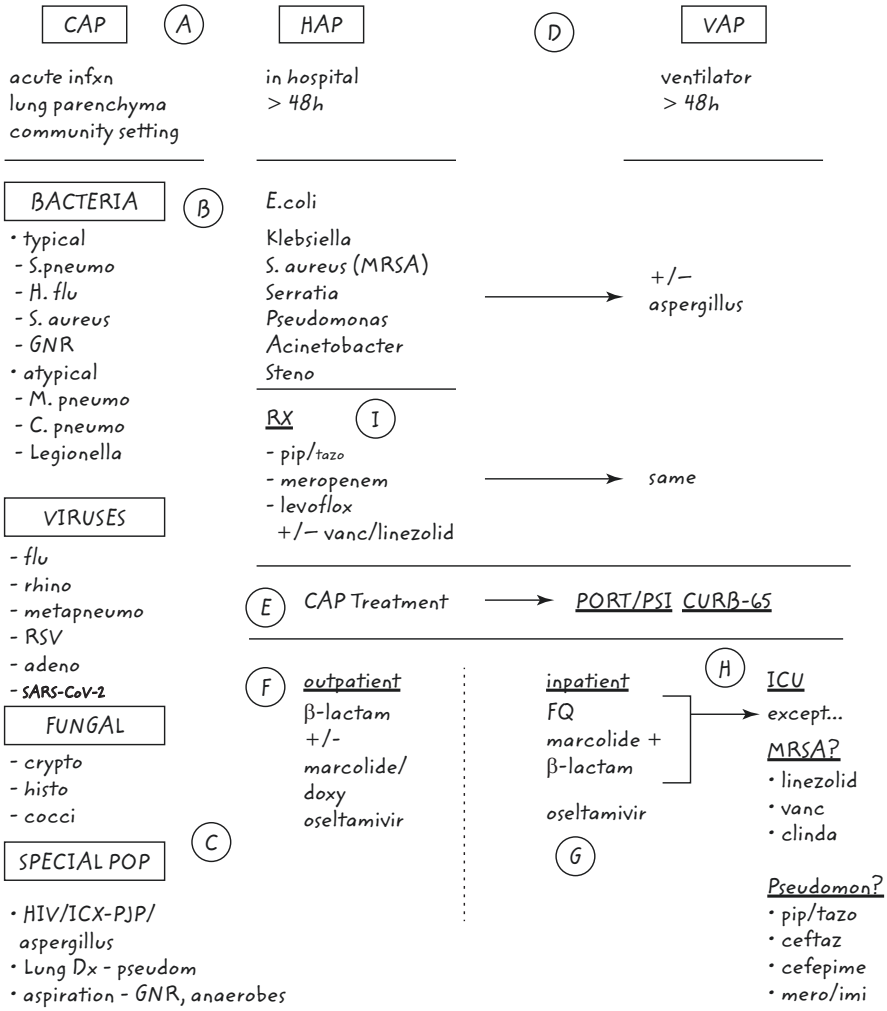

Fig. 30.1 Management of pneumonia, A–I

B. **What pathogens are the most likely cause of our patient's pneumonia?**

Make headings for "bacteria," "viruses," and "fungal," and add organisms as listed by the learners.

Teaching points

- Typical bacteria—*S. pneumoniae* (25–30% of cases), *H. influenza*, S. *aureus*, gram negative rods (GNRs) such as Klebsiella and Pseudomonas spp.
- Atypical bacteria—*Mycoplasma pneumonia*, *Chlamydophila pneumoniae, Legionella pneumophila.*
- Viruses—influenza, SARS-CoV-2 rhinovirus, metapneumovirus, respiratory syncytial virus, adenovirus.
- Fungal—Note that typically those at risk for fungal pneumonia are immunocompromised, but immunocompetent patients can also get *Cryptococcus neoformans, Histoplasma capsulatum, Coccidioides spp.*

C. **Some historical elements can suggest other pathogens. What pathogens would you add to your differential in patients with the following risk factors or comorbidities?**

Ask for pathogens associated in the following scenarios:

- HIV or immunosuppression?—all of the above, plus, *Pneumocystis jiroveci*, *Aspergillus fumigatus*, mycobacteria spp.
- Structural lung disease?—Pseudomonas spp., *Burkholderia cepacia*
- High aspiration risk?—GNRs, anaerobes if poor dentition
- Animal exposures?—bat or bird droppings—*Histoplasma*, Rabbits—*Francisella tularensis,* Birds—*Chlamydophila psittaci*
- Recent hotel stay or cruise ship trip?—Legionella

D. **If your patient were already admitted to the hospital for greater than 48 h (HAP) or had been on a ventilator for greater than 48 h (VAP), what pathogens would you have to worry about?**

List the pathogens under HAP and VAP as shown in Fig. 30.1.

Teaching points

- Hospital-acquired pneumonia (HAP): *E coli, Klebsiella, Enterobacter, S aureus (MRSA), Serratia, Pseudomonas, Acinetobacter, Stenotrophomonas*
- Ventilator-associated pneumonia (VAP): same as HAP; consider Aspergillus if immunocompromised
- Note that for HAP and VAP, you must consider multi-drug resistant (MDR) organisms such as MRSA and GNR like Pseudomonas or E coli that have multi-drug resistance patterns, as clinical concern for these should inform empiric antibiotic selection.

E. **Your patient has no other medical problems, has not been recently hospitalized, nor has been treated with antibiotics in the past 6 months. Other than a WBC of 17 k, the rest of his CBC and Chem 7 are normal. Should he be admitted to the hospital? How would you decide?**

Write down PORT/PSI and CURB-65, highlighting the importance of objective risk stratification.

Teaching points

- Several tools are available to risk-stratify the patient and aid in management decisions.
- Commonly used tools include the PSI/PORT score, which includes age, sex, nursing home residency, medical comorbidities, vital sign abnormalities, laboratory data, and imaging findings.
- The CURB-65 score is easy to remember (confusion, BUN > 20, RR > 30, SBP < 90 or DBP < 60, and age >65)—hospital admission should be considered for anyone with two or more features.
- Low-risk patients (those who are less sick), such as our patient, can be treated an outpatient.

F. **You decide that your patient is low risk and can be treated as an outpatient. What antibiotics would you send him home with?**

Write down antibiotics under "outpatient."

Teaching points

- Consult local antibiotic susceptibility and practice patterns for specific antibiotic recommendations—general guidelines are given here.
- Beta-lactam (amoxicillin or amox/clav) +/- a macrolide or doxycycline, oseltamivir if concerned for influenza (*note that adding oseltamivir is true for all the categories of pneumonia and treatment settings discussed).*

G. **What if our patient's labs came back with a creatinine of 2, BUN of 40, and was requiring 2 L nasal cannula oxygen to maintain his oxygen saturation at 95%, had a respiratory rate of 20, was tachycardic to 105, and his BP was 127/78?**

Write down antibiotics under "inpatient."

Teaching points

- Higher risk patients (i.e., those who are more sick) should be admitted and further stratified to floor or ICU level care based on hemodynamic stability.
- This patient sounds stable for the acute care floor—macrolide and beta-lactam are preferred, may consider fluoroquinolone.

H. **As we are putting in admission orders, we hear that our patient is now requiring 8 L nasal cannula oxygen to maintain his oxygen saturation at 95%, his respiratory rate has increased to 32, his heart rate is now 127, and**

his blood pressure is now 95/60. Where does this patient get admitted to the hospital and what antibiotics would you choose?

Write down antibiotics under "ICU."

Teaching points

- This patient should be admitted to the ICU but the antibiotic recommendations are the same as for floor patients, unless there is concern for MRSA or *Pseudomonas spp.*
- For which patients would you worry about MRSA?—ESRD, IVDU, recent influenza-like illness, fluoroquinolone therapy in the past 3 months, necrotizing or cavitary pneumonia on imaging.
- Which antibiotics would cover MRSA?—vancomycin, linezolid, clindamycin.
- For which patients would you worry about Pseudomonas?—Patients with cystic fibrosis or other structural lung disease, a tracheostomy, neutropenia, or otherwise immunocompromised.
- Which antibiotics would you use to empirically cover Pseudomonas while awaiting culture data?—Piperacillin-tazobactam, ceftazidime, cefepime, meropenem, or imipenem if worried about extended spectrum beta lactamases.

I. **What is different about HAP and VAP treatments?**

Write down the antibiotics that you would consider for patients with VAP or HAP.

Teaching points

- S. aureus and pseudomonas must be considered and covered for, and MRSA should be covered with vancomycin or linezolid if there is a >20% prevalence based on local sensitivity patterns.
- Antibiotics to use empirically if no MDR risk factors include cefepime, piperacillin-tazobactam, meropenem may consider levofloxacin if no MDR.
- Antibiotics to consider for empiric treatment for VAP are the same as HAP—aspergillus can be considered as a potential pathogen in patients with VAP.

Return to Objectives and Emphasize Key Points

1. Understand how to categorize pneumonia and how this affects decisions for patient care. First categorize based on the type of pneumonia.
    - CAP
    - HAP
    - VAP
2. Further categorize CAP based on severity.
    - Severity scores ➔ treatment in either outpatient or inpatient setting with inpatient further stratified to acute care floor vs. ICU

3. Describe the basic microbiology of pneumonias.
    - Note that this varies depending on if you are treating CAP, HAP, or VAP, and resistance patterns. Refer back to the most common organisms learners should be concerned about for each type of pneumonia
    - Must take into account exposures and patient characteristics.
4. Develop a framework for treating pneumonia.
    - Remind learners that their antibiotic selection should cover the organisms that they are concerned for, taking into account local antibiotic susceptibilities.

Resources

1. Wunderink RG, Waterer GW. Clinical practice. Community-acquired pneumonia. N Engl J Med. 2014;370(6):543–51, full-text, commentary can be found in N Engl J Med 2014 May 8;370(19):1861.
2. Mandell LA, Wunderink RG, Anzueto A, et al. Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults. Clin Infect Dis. 2007;44(Suppl 2):S27–72, full-text, commentary can be found in Clin Infect Dis 2007 Jul 1;45(1):133.
3. File TM. Community-acquired pneumonia. Lancet. 2003;362(9400):1991–2001.
4. Watkins RR, Lemonovich TL. Diagnosis and management of community-acquired pneumonia in adults. Am Fam Physician. 2011;83(11):1299–306, full-text.
5. Kalil AC, Metersky ML, Klompas M, et al. Management of Adults with Hospital-acquired and Ventilator-associated Pneumonia: 2016 clinical practice guidelines by the Infectious Diseases Society of America and the American Thoracic Society. Clin Infect Dis. 2016;63(5):e61–e111, full-text.
6. 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 RespirCrit Care Med. 2005;171(4):388–416, commentary can be found in Am J RespirCrit Care Med 2006 Jan 1;173(1):131.
7. Morrow LE, Kollef MH. Recognition and prevention of nosocomial pneumonia in the intensive care unit and infection control in mechanical ventilation. Crit Care Med. 2010;38(8 Suppl):S352–62.
8. Nair GB, Niederman MS. Nosocomial pneumonia: lessons learned. Crit Care Clin. 2013;29(3):521–46.
9. Kass SM, Williams PM, Reamy BV. Pleurisy. Am Fam Physician. 2007;75(9):1357–64.
10. Hunter JD. Ventilator associated pneumonia. BMJ. 2012;344:e3325.
11. Muscedere J, Dodek P, Keenan S, Fowler R, Cook D, Heyland D, VAP Guidelines Committee and the Canadian Critical Care Trials Group. Comprehensive evidence-based clinical practice guidelines for ventilator-associated pneumonia: prevention. J Crit Care. 2008;23(1):126–37, commentary can be found in J Crit Care 2009 Mar;24(1):149.