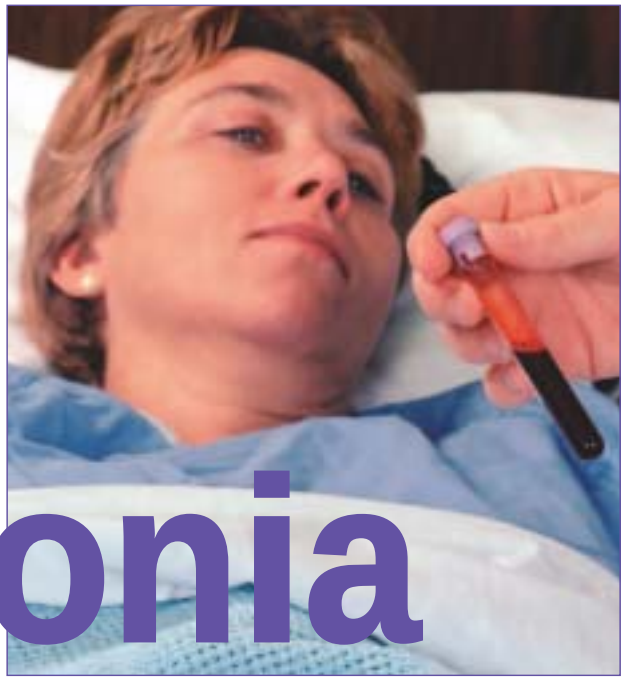
Diagnosis of Community-Acquired Pneumonia



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In North America, pneumonia is the sixth leading cause of death and the major cause of death due to infectious diseases.[1,2,3] There are an estimated 5.6 million cases of community-acquired pneumonia (CAP) in the U.S. every year, and 1.1 million hospital admissions.[1] The mortality of CAP is 1% to 5% in the outpatient setting but increases to 12% in hospitalized patients.[1]

Definitions

A CAP is a lower respiratory tract infection in an ambulatory patient who has not recently been hospitalized. Nosocomial pneumonia, or hospital-acquired pneumonia, is defined as a pneumonia occurring 48 hours or more after admission.[4]

Another commonly used set of terms is typical and atypical pneumonia. Historically, the classic lobar or typical pneumonia was caused by *streptococcus pneumococcus*, although other bacteria can cause a similar clinical and radiographic appearance.[1] Atypical pneumonias are considered to have clinical and radiographic characteristics different from those of classic or lobar pneumonias.[5] The organisms most commonly causing atypical pneumonias include *Legionella*, *Mycoplasma*, *Chlamydia* and viral organisms.[5]

Risk factors

Several risk factors for pneumonia have been identified. Alcoholism, asthma, immunosuppression, institutionalization, and age over 70 all increase the risk of pneumonia.[1] Additional risk factors for specific etiologic agents are summarized in Table 1.

Etiology

The most likely etiologic agent of CAP depends on the patient population and the severity of the illness. An etiologic agent can be identified in less than half of all patients with CAP.[1,3] *Streptococcus pneumoniae* is the most commonly identified pathogen, followed by *Haemophilus influenzae*, *Staphylococcus aureus*, enteric gram negatives, *Legionella*, *Chlamydia pneumonia*, and viruses.[1,2] In patients who did not require hospitalization, *Mycoplasma pneumoniae* was the most commonly isolated organism, followed by *streptococcus pneumoniae*, *Haemophilus influenzae*, and *Chlamydia pneumonia*.[1,6] On the other hand, among patients who were sick enough that they were hospitalized for CAP *streptococcus pneumococcus* was the most common organism, followed by *Haemophilus influenza*, *Staphylococcus aureus*, *Legionella*, *Mycoplasma* and enteric gram-negative rods.[1,6] Finally, among patients with overwhelming pneumonia, who require admission to an intensive care unit, the most common organisms are *Legionella* and *Streptococcus pneumoniae* followed by *Staphylococcus aureus* and enteric gram-negative rods.

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Table 1

ORGANISM	RISK FACTORS
S. pneumoniae	Age > 70
	Recent Beta-Lactam therapy (3 months)
	Alcoholism
	Immunosuppression
	Corticosteroid therapy
	Medical comorbidities
	Exposure to a child in day care
Enteric Gram-negatives	Nursing home residence
(*E. Coli*, *Klebsiella*, *Serratia*)	Cardiopulmonary disease (COPD, CHF)
	Other medical illnesses (diabetes, renal)
	Recent antibiotic therapy
Pseudomonas aeruginosa	Structural lung disease (bronchiectasis)
	Corticosteroid therapy
	Broad spectrum antibiotic therapy for more than seven days in the past month
	Malnutrition

Adapted from American Thoracic Society: Guidelines for the management of adults with community acquired pneumonia. Am J Respir Crit Care Med 2001; 163:1730-54.

Symptoms and signs

Patients with CAP usually present with acute onset of lower respiratory symptoms including a productive cough, pleuritic chest pain, or dyspnea.[1-3,6] Nonrespiratory symptoms may be present in 10% to 30% of patients and include myalgias, arthralgias, or headache.[1,6] Initially, atypical pneumonias were thought to present with primarily extrapulmonary manifestations and few respiratory symptoms. This has been shown to be untrue and these are are no longer considered to comprise a separate syndrome.[1,5]

Physical examination findings depend on the severity of the illness. Most patients will have fever, tachypnea, and tachycardia,

while some may have hypotension.[1,7,8] Chest examination may reveal dullness to percussion, decreased breath sounds, crackles, bronchial breathing, *rhonchi* or egophony.[1,7,8] Several algorithms for prediction of the probability of pneumonia, based on history and physical examination, have been proposed. However, the reliability of the chest examination is poor, with substantial differences between observers, which limits the accuracy of these predictive algorithms.[8]

Diagnostic tests

Although CAP can be suspected from typical symptoms and physical findings, a chest radiograph with posteroanterior and lateral views should be performed in all patients suspected of having a CAP.[1,9] In addition to confirming the diagnosis, the radiographic pattern may aid in determining the etiologic agent. A focal nonsegmental or lobar pneumonia is typically seen with *pneumococcus*. Other organisms which may present with a similar pattern include *Klebsiella*, and *Legionella*.[4,9] A segmental or multifocal bronchopneumonia can be seen with *Staphylococcus aureus*, *Streptococcus pyogenes*, *Pseudomonas*, *Haemophilus*, *Moraxella catarrhalis*, and *Escherichia coli*.[4,9] Viral, *Mycoplasma*, or *Pneumocystis carinii* pneumonias usually have interstitial changes on chest radiograph.[4,9] A chest radiograph can also be used to identify unusual causes of lung infections such as tuberculosis or lung abscess. Radiographic findings of multilobar disease or pleural effusion are signs of more severe disease.[1] Pleural effusions are seen in 36% to 57% of patients with pneumonia, and are most common with pneumococcal pneumonia.[10]

Routine blood tests, including complete blood count (CBC), electrolytes and renal function, should be obtained on all hospitalized patients. They are not routinely recommended for outpatients with CAP.[1,10] Hospitalized patients also should have an oxygen saturation via pulse oximetry or an arterial blood gas if the patient is very ill.[1,10]

Microbiological testing, including sputum gram stain, sputum culture and blood cultures, are non-invasive tests which are essential to identifying a specific causative organism.[2,3] Although microbiologic tests are not routinely recommended in outpatients, they should be obtained for all patients who are sick enough to require hospitalization. It is essential that these

are obtained prior to initiation of antibiotic therapy, because the information from microbiologic tests obtained during, or after, antibiotic therapy is of little or no value, and may be misleading.[1,10] This does not mean that appropriate antibiotic therapy should be delayed in order to obtain sputum or blood cultures. Rather these tests should be done promptly, as soon as the diagnosis of pneumonia is considered in a patient who is, or will be, hospitalized.

Sputum gram stains and cultures can be useful when a proper specimen, without salivary contamination, is collected.[1,10] However, many sputum samples are inadequate and of no use. The gram stain should be interpreted according to strict criteria by an experienced observer. To be useful, the specimen should have fewer than 10 squamous cells and more than 25 neutrophils per low-power field, and one bacterial species should predominate on high-powered field.[10] If these criteria are met, the sputum gram stain can help guide selection of initial antibiotic therapy. Sputum gram stains and sputum cultures should be obtained prior to antibiotic therapy as even a single antibiotic dose can suppress bacterial growth. The yield from sputum culture is variable and has ranged between 20% to 79% in different studies.[10]

Blood cultures obtained in hospitalized patients before initiation of antibiotics, will be positive in up to 18% of patients with CAP.[1,10] The yield of blood cultures will be less than 5% if patients have received antibiotics before the blood cultures were drawn.[10]

Thoracentesis should be done in all patients with CAP who develop a significant pleural effusion, particularly if fever persists after initiation of appropriate antibiotics. A lateral ducubitus chest radiograph should be performed to confirm the presence of pleural fluid, and to determine if the layer of fluid is at least 10 mm thick — less than this is not clinically significant and is technically difficult to tap.[10] A diagnostic thoracentesis should be performed, and the sample of fluid obtained sent for pH, glucose, protein, LDH, cell count and differen-

tial, as well as gram stain and culture. Results of these tests can be used to diagnose empyema, which would require management with a drainage procedure. Other invasive tests are not recommended.

Criteria for hospitalization

Once the diagnosis of pneumonia has been established, a decision regarding hospitalization of the patient must be made. The clinical, laboratory and radiographic characteristics associated with greater likelihood of a complicated course are summarized in Table 2.[1,11]

The Patient Outcomes Research Team (PORT) study created an algorithm to aid in the decision for hospitalization of patients with community acquired pneumonia.[11] Patients were divided into five risk classes

Table 2

RISK FACTORS FOR SEVERE DISEASE

Age > 65

Comorbid illness (COPD, DM, CHF, CRF, liver disease, malignancy, malnutrition, alcohol abuse, cerebrovascular disease or post splenectomy)

Respiratory rate: >30

Blood pressure: Diastolic <60, Systolic <90.

Heart rate: >125

Temperature: <35 or >40

Altered mental status

White blood cells < 4,000 or > 30,000

Arterial blood gas: P_aO_2 < 60 or P_aCO_2 > 50

pH < 7.35

Abnormal renal function

Hematocrit < 30% or hemoglobin < 90

Disseminated intravascular coagulation

Chest radiograph findings:

• Multilobar disease • Cavitary lesion •Pleural effusion

Adapted from American Thoracic Society: Guidelines for the management of adults with community acquired pneumonia. Am J Respir Crit Care Med 2001;163:1730-54.

Table 3

POINT SCORING SYSTEM

Patient Characteristics	Points
Age (Male)	Age (years)
Age (Female)	Age (years)-10
Nursing home resident	10
Comorbidities:	
Neoplastic disease	30
Liver disease	20
Congestive heart failure	10
Cerebrovascular disease	10
Renal disease	10
Physical exam:	
Altered mental status	20
Respiratory rate > 30 breaths per minute	20
Systolic blood pressure < 90 mm Hg	20
Temperature < 35° C or > 40° C	15
Pulse > 125 beats per minute	10
Laboratory findings:	
Arterial pH < 7.35	30
Blood urea nitrogen > 11 mmol/L	20
Sodium < 130 mmol/L	20
Glucose > 14 mmol/L	10
Hematocrit < 30%	10
Partial pressure of arterial oxygen < 60 mmHg	10
Radiographic findings:	
Pleural effusion	10

Adapted from Fine MJ, Auble TE, Yealy DM, et al: A prediction rule to identify low-risk patients with community acquired pneumonia. N Engl J Med 1997; 336: 243-50.

Table 4

RISK CLASSES AND NEED FOR HOSPITALIZATION

Risk	Risk class	Points	Hospitalization?
Low	I	0	No
Low	II	1-70	No
Low	III	71-90	No
Moderate	IV	91-130	Yes
High	V	>130	Yes

Adapted from MJ, Auble TE, Yealy DM, et al: A prediction rule to identify low-risk patients with community acquired pneumonia. N Engl J Med 1997; 336: 243-50.

Table 5

ETIOLOGIC AGENTS AND RECOMMENDED EMPIRIC THERAPY-BASED ON UNDERLYING ILLNESSES, AND NEED FOR HOSPITALIZATION

PATIENT GROUP	*LIKELY ORGANISMS*	*THERAPY*
Hospitalization not required. N0 cardio-pulmonary disease	Pneumococcus Mycoplasma Chlamydia Haemophilus Viruses Legionella	Advanced generation macrolide (*i.e.,* azith-romycin) or doxycycline
Hospitalization not required with cardio-pulmonary disease	Pneumococcus Mycoplasma Chlamydia Mixed infections Haemophilus Enteric gram-negatives Viruses	Beta-lactam (*i.e.*, cefur-oxime)plus macrolide or doxycycline or antipneu-mococcal fluoroquinolone (*i.e.,* levofloxacin)
Hospitalization required, but not intensive care unit (ICU) admission	Pneumococcus Haemophilus Mycoplasma Chlamydia Mixed infections Viruses Legionella Enteric gram-negatives	IV Beta-lactam PLUS Macrolide or doxycycline or IV antipneumococcal fluoroquinolone
ICU admission required	Pneumococcus Legionella Haemophilus Enteric gram-negatives Staph. aureus Mycoplasma Viruses	IV Beta-lactam PLUS either IV macrolide or IV fluoroquinolone (if risk for pseudomonas, cover with appropriate antibiotics)

Adapted from American Thoracic Society: Guidelines for the management of adults with community-acquired pneumonia. Am J Respir Crit Care Med 2001; 163:1730-54.

based on scores derived from clinical history, physical examination, laboratory and radiographic findings (Table 3). Patients in risk classes I to III had low risk of complications, or death within 30 days. These patients should not require hospitalization (Table 4). Patients in classes IV and V should be hospitalized.

Summary and Conclusion

The most likely etiologic agents of CAP can be predicted, based on need for hospitalization or ICU admission, and presence of underlying illnesses, as shown in Table 5.[1] Based on our understanding of the most commonly seen etiologic agents in each group, current therapeutic guidelines are tailored towards those agents most commonly seen (Table 5), among patients grouped into four categories.

In conclusion, all patients suspected to have CAP should have a careful history to elicit risk factors for pneumonia, and a more complicated course. Physical exam, particularly the vital signs, can give clues to the presence, and severity of pneumonia. A chest radiograph should be performed to confirm the diagnosis, provides clues to the likely etiologic agent, and further information on the severity of illness. Taken together, the history, physical exam and chest radiograph will help identify patients who should be hospitalized. These patients should have additional investigations — particularly sputum samples for gram stain and culture as well as blood cultures before initiation of antibiotics. Pulse oximetry or arterial blood gases are important to identify patients with potential respiratory failure, who may need ICU admission. Patients with CAP should be treated with antibiotics selected on the basis of the most likely etiological agents, following recently published guidelines which are summarized here. Hospitalized patients should be monitored closely for signs of improvement, while patients who are treated as out-patients require a follow-up visit to confirm resolution. Dx

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