Diagnosis of Community Acquired Pneumonia

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Pneumonia is a clinical syndrome compatible with lower respiratory tract infection associated with consolidation seen on a plain X-ray, together with the identification of a respiratory pathogen from a clinical specimen.

Community acquired pneumonia (CAP) is pneumonia that has been acquired in a community in a patient who has not been hospitalized within 14 days prior to onset of symptoms[1] or hospitalized less than 4 days prior to onset of symptoms.

Diagnosis of CAP is a challenge to the evaluating physician as this condition closely mimics the common cold or flu. Appropriate medical history[2,3] and physical examination are an important part of making pneumonia diagnosis. It is characterized by a constellation of signs and symptoms,[4] ranging from cough, purulent sputum production, dyspnea, pleuritic chest pain, fever, chills, tachypnea, tachycardia, localizing signs on chest examination with reduced expansion on the affected side, signs consistent with consolidation like impaired percussion note, high pitched bronchial breathing with increased vocal resonance and rales on examination etc.

In a patient with advanced age or an inadequate immune response, pneumonia may present with non respiratory symptoms such as confusion, failure to thrive, worsening of an underlying chronic illness.

Table 1 : Diagnosis of pathogen based on specific features

Organism	Clinical features
Streptococcus pneumoniae	Increasing age, Cardiovascular diseases, Acute onset, high fever and pleuritic chest pain
Streptococcus pneumoniae	Alcohol, diabetes, COPD, dry or no cough, female
Legionella	Young patient, smokers, absence of co morbidity, neurological symptoms, evidence of multisystem involvement
Mycoplasma pneumoniae	Younger patient, prior antibiotics, less multisystem involvement, haemolysis, cold agglutinins, hepatitis, skin and joint problems
Staphylococcus aureus	Recent influenza like illness
Chlamydia psittaci	Long duration of symptoms prior to admission like headache
Coxiella burnetti	Dry cough, high fever, headache, male, animal exposure
Klebsiella pneumoniae	Low platelet count and leucopenia, male
Acinetobacter	Older patients, history of alcoholism, high mortality
Streptococcus millleri	Dental or abdominal source of infection
Streptococcus viridans	Aspiration history

Table 2 : Signs and symptoms of pneumonia in Elderly (>65yrs)[5]

Respiratory symptoms	Non respiratory symptoms
Cough (66-84%)	Chills (23-51%)
Sputum production (53-55%)	Sweats (45-55%)
Pleuritic chest pain (17-45%)	Fatigue (84-88%)
Haemoptysis (3-13%)	Abdominal pain (18%)
Dyspnea (70-80%)	Anorexia (57-64%)
	Altered mental status (11-45%)
	Malaise (8-23%)

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The Role of Clinical Features in Predicting Microbial Etiology of CAP

The clinical features of CAP cannot be reliably used to establish the etiologic diagnosis of pneumonia with adequate sensitivity and specificity, but in some situations it is possible.

Findings on physical examination

Fever (40-78%)

Tachypnea (65-68%)

Tachycardia (37-40%)

Rales (77-84%)

Diagnostic criteria for CAP without access to a chest X-ray[6] (BTS guidelines):

- Symptoms of an acute lower respiratory tract illness (cough plus another lower tract symptom, e.g. dyspnoea, pleuritic pain).
- New focal chest signs on examination (e.g. bronchial breathing).
- One of: sweating; fever; shivers; myalgia; or pyrexia > 30ºC.
- No other explanation for the illness.

Identification of risk factors[2,3] are equally important in the diagnosis of CAP and some of them are:

- Alcohol or drug abuse
- Exposure to people with pneumonia or other respiratory

Table 3 : Possible organisms - risk factors

Risk factor	Possible organisms
Aspiration	Anaerobes and Gram negative organisms
Alcoholism and Diabetes	Pneumococcal, Anaerobic and mixed infections
Immunosuppression	Legionella
Cigarette smoking	Invasive Pneumococcal disease
COPD	Haemophilus influenzae and moraxella catarrhalis
Nursing home residents	Haemophilus influenzae, Mycoplasma pneumoniae and Legionella
Health care worker	Mycobacterium tuberculosis
Veterinarian	Coxiella burnetti
Cooling tower maintenance work	Legionella
Travel to S.E Asia	Burkholderia psuedomallei, M. tuberculosis
Travel to china,, Taiwan, Toronto	Corona virus
Pneumonia out breaks in military training camps	S. pneumoniae, Chlamydia pneumoniae, Adeno virus
Lawn mowing in endemic area	Francisella tularensis
Sleeping in rose garden	Sporothrix schenckii

illnesses (such as tuberculosis)
- History of diabetes
- History of chronic obstructive airway disease
- History of smoking
- Occupational risks
- Recent or chronic respiratory infection
- Recent travel
- Environmental factors

Laboratory Tests

1. Chest x-ray PA and lateral view

   Chest radiography may reveal a lobar consolidation, which is common in typical pneumonia most commonly in the lower lobes; or it could show bilateral diffuse interstitial infiltrates and cavitations. They are also used to evaluate for complications of pneumonia like empyema, lung abscess, pneumothorax etc.

   The chest x ray sometimes gives a clue for suspecting the etiological agent.

   a. Multi lobar involvement (Bacteraemic pneumococcal)
   b. Pleural effusions (Bacteraemic pneumococcal)
   c. Lymphadenopathy (Mycoplasma infection)
   d. Multilobe involvement, cavitation, or spontaneous pneumothorax (Staphylococus aureus).
   e. Upper lobe preponderance may denote klebsiella pneumonia.

   In some cases, chest CT (computed tomography) can reveal pneumonia that is not seen on chest x-ray. One study has shown that some of these radiographically negative patients do have lung infiltrates if a high-resolution computed tomography scan of the chest is done.[7]

2. Blood picture

   A complete blood count may show a high white blood cell count, indicating the presence of bacterial infection. Leucopenia may suggest viral pneumonia.

3. Sputum gram stain and culture[8]

   The presence of > 25 white blood cells and, 10 squamous epithelial cells per high power field suggests that the sputum is appropriate for examination. Specialized cultures for *Mycobacterium* sp., *Legionella* sp., and endemic fungi may be valuable in the appropriate clinical circumstance. If the patient is not receiving antibiotics at the time of admission sputum culture and sensitivity results may be useful. Viral cultures are not useful in the initial evaluation of patients with community-acquired pneumonia and should not be routinely performed.[9]

4. Blood culture

   Blood cultures are positive in 5 -14% of cases, most commonly yielding streptococcus pneumoniae. Culture sent within 24 hours of presentation is associated with improved 30 day survival in patients with CAP.[10]

5. Blood chemistry

   Glucose, electrolytes, Liver and renal fuction tests should be done.

   Electrolyte imbalance usually seen is hyponatremia, is thought to be due to excess anti-diuretic hormone produced by the diseased lungs (SIADH – syndrome of inappropriate ant diuretic hormone).

6. Pulse oximetry
7. ABG – If oxygen saturation < 90%
8. Serum antibodies - Detection of antibodies to Streptococcus pneumonia, mycoplasma , chlamydia , adenovirus, influenza A and B viruses, parainfluenza viruses 1, 2, and 3, and respiratory syncytial virus etc
9. Polymerase Chain Reaction (PCR) - useful for identifying certain atypical bacteria strains, including mycoplasma, Chlamydia pneumonia and Haemophilus influenzae type b. One study found that using a real-time PCR test may help quickly diagnose Pneumocystitis pneumonia in HIV-positive patients.
10. Urine antigen tests for Legionella pneumophila (Legionnaires' disease) and Streptococcus pneumoniae may be performed in patients with severe CAP.
11. Thoracentesis if pleural effusion is significant
    – Pleural fluid thickness > 10 mm thickness in lateral decubitus view.
12. Bronchoscopy –
    - Bronchoalveolar lavage, protected specimen brush

Diagnostic Difficulties in Community-Acquired Pneumonia (CAP)

It is important to determine whether the cause of CAP is a bacterium, atypical bacterium, or virus, because they require different treatments. Microbiological tests are not completely reliable in identifying the etiology of pneumonia, and in 40-70% of pneumonia cases, the etiology is never determined.

IDSA/ATS guidelines suggest that more aggressive diagnostic testing should only be performed on the subset of patients with more serious illness, in patients with structural lung disease or pleural effusion.[11]

Assessing the severity of CAP (prognostic scoring)

Studies have shown that delay in treatment or delay in admission to the ICU leads to high mortality [Restrepo et al. 2010]. Multiple prediction rules are the IDSA/ATS criteria for severe CAP, and the PSI, the British CURB-65, the Australian SMART-COP, and the Spanish CURXO-80 are also available.

None of the scoring systems are ideal but the two major tools of severity assessment are the PSI and the CURB score and its modification (CURB-65).

CURB and CURB-65

Confusion of new onset (mini mental score<8)

Urea >7 mmol/L

Respiratory rate >30/min

Blood pressure:

<90 mmHg systolic and/or

<60 mmHg diastolic

Age >65

Stratified mortality

CURB score	CURB65 score
0 or 1 = 1.5%	0 = 1.2%
2 = 9.2%	1 or 2 = 8.15%
3 or more = 22%	3 or 4 = 31%

PSI (pneumonia severity index)

The purpose of the PSI is to classify the severity of a patient's

pneumonia to determine the amount of resources to be allocated for care. Most commonly, the PSI scoring system has been used to decide whether patients with pneumonia can be treated as outpatients or as inpatients. Fine and colleagues recommended that all class I patients and many class II and III patients were candidates for outpatient therapy, while class IV and V patients, associated with high mortality, should be managed in hospital.[12]

The PSI score is limited, due to the impact of age on the score, and the possibility of underestimating the severity of illness in younger populations while overestimating the severity in elderly population and patients with co-morbidities.[13]

Demographics	**Points Assigned**
If Male	+Age (yr)
If Female	+Age (yr) – 10
Nursing home resident	+10
Comorbidity	
Neoplastic disease	+30
Liver disease	+20
Congestive heart failure	+10
Cerebrovascular disease	+10
Renal disease	+10
Physical Exam Findings	
Altered mental status	+20
Pulse ≥125/minute	+20
Respiratory rate >30/minute	+20
Systolic blood pressure <90 mm Hg	+15
Temperature <35°C or ≥40°C	+10
Lab and Radiographic Findings	
Arterial pH <7.35	+30
Blood urea nitrogen ≥30 mg/dl (9 mmol/liter)	+20
Sodium <130 mmol/liter	+20
Glucose ≥250 mg/dl (14 mmol/liter)	+10
Hematocrit <30%	+10
Partial pressure of arterial O2 <60mmHg	+10
Pleural effusion	+10

Point total	**Risk**	**Risk class**	**Mortality %**	**Recommended site of care**
No predictors	Low	I	0.1	Out patient
< 70	Low	II	0.6	Out patient
71 to 90	Low	III	2.8	Inpatient(briefly)
91 to 130	Moderate	IV	8.2	Inpatient
> 130	High	V	29.2	Inpatient

PSI had higher sensitivity and higher negative predictive value for mortality than CURB and CURB- 65[14].

A similar approach has been developed by the Japanese Respiratory Society, the A-DROP scoring system that assesses: age (male ≥ 70 years, female ≥75 years); dehydration (BUN ≥ 210 mg/ l); respiratory failure (SaO2 ≤ 90% or PaO2 ≤ 60 mmHg); orientation disturbance; and low blood pressure (systolic < 90mmHg).[15]

Shindo et al compared A-DROP and CURB- 65 in CAP patients and found that the sensitivity, specificity, and 30-day mortality predictive value of the A-DROP scoring tool were equivalent to the CURB-65.[16]

Recently, other scoring systems such as SCAP, SMART-COP, and PIRO have been applied to CAP patients.

The IDSA/ATS criteria for severe community acquired pneumonia:[17]

Minor criteria:

1. Respiratory rat ≥30 breaths/min
2. PaO2/FiO2 ratio ≤ 250
3. Multilobar infiltrates
4. Confusion/disorientation
5. Uremia (BUN level ≥20mg/dL)
6. Leukopenia (WBC <4000 cells/mm3)
7. Thrombocytopenia (platelet count <100,000 cells/mm3
8. Hypothermia (core temperature <36°C)
9. Hypotension requiring aggressive fluid Resuscitation

Major criteria

1. Invasive mechanical ventilation
2. Septic shock with the need for vasopressors.

*Admission to ICU is warranted if one major or three minor criteria are fulfilled.

Biomarkers

In addition to the above severity prediction tools, several biomarkers have been recognized as markers of severe inflammation in CAP such as procalcitonin (PCT), C-reactive protein (CRP), and pro-adrenomedullin. Elevated levels of copeptin, natriuretic peptides, cortisol, proatrial natriuretic peptide and coagulation markers are also significantly related to mortality in CAP.

Associations with 30-day mortality from CAP[6]

- Older age (in adults).
- Co-morbidity (especially: cancer, liver, kidney or neurological disease, heart failure, alcohol).
- Raised respiratory rate.
- Confusion.
- Hypotension.
- Hypoalbuminaemia.
- Hypoxia.
- High or low white cell count.
- Bilateral X-ray changes.
- Positive blood culture.
- No pyrexia in the elderly.

Indicators of severity derived from African studies on CAP: factors associated with a five-times or greater risk of death[18]

1. Age >55.
2. Use of traditional healer.
3. Diastolic blood pressure<60mmHg,
4. Respiratory rate >30.
5. Pulse >120 beats/min.

A note on tuberculosis

In areas with a high burden of TB and in particular where HIV rates are also high, inevitably capture some cases of TB. Even when X-rays are available there is much overlap between the radiological manifestations of CAP and pulmonary TB. In general CAP may manifest with a more acute onset of symptoms whereas TB often has an element of chronicity; however, these distinctions will not be consistently reliable. In practice, if CAP is suspected, treatment should be initiated and if the clinical condition does not improve as66 expected, the possibility of TB should be entertained and sputum smears performed.

Pneumonia and HIV

CAP is common in those with advanced immune suppression from HIV. The spectrum of bacterial pathogens is similar to the non-HIV-infected population but other opportunistic pathogens assume a greater significance, in particular *Pneumocystis jiroveci, Streptococcus pneumoniae* remains the commonest bacterial pathogen and evidence suggests standard severity scoring algorithms are valid in the context of HIV.

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