Complications of Pneumonia in Children

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CL, a 5-year-old girl, has been highly febrile for 5 days. Her aunt claims that her niece has been coughing for nearly 3 weeks despite intake of Ambroxol syrup.

PE: HR 112/min, RR 35/min, T 38.4°C; decreased breath sounds and increased vocal fremiti on the right lung field.

The etiology of pneumonia is difficult to determine and initial choice of therapy is based on:

- frequency of pathogens in various age groups
- local antibiotic resistance patterns of the organisms
- clinical presentation
- epidemiological data

In 2005, ALRI and Pneumonia leads in morbidity with 692,305 reported case or a rate of 830.1 per 100,000 population.
Most common pathogens based on presentation:

**Typical**
- Streptococcus
- Hemophilus
- Staphylococcus

**Atypical**
- Chlamydia
- Mycoplasma
- Legionella
- Viral

**Nosocomial**
- Pseudomonas
- Klebsiella
- E. coli
- Enterobacter

**Immunocompromised**
- Pneumocystis

**Bacterial Pathogens**
- S. pneumoniae
- Moraxella catarrhalis
- Haemophilus influenzae

**Atypical Pathogens**
- Mycoplasma pneumoniae (non-typable)
- Chlamydia pneumoniae

**Viral Pathogens**
- Respiratory syncitial virus
- Influenza A and B
- Adenovirus
- Rhinovirus, Enterovirus, Human Metapneumovirus

Adolescents may demonstrate the classic adult presentation of pneumonia, including:
1. abrupt onset of symptoms
2. high fever
3. productive cough
4. pleuritic chest pain, and
5. possible toxic appearance.

The presentation of the younger child with PCAP is often subtle:
1. Fever
2. Lethargy
3. Tachypnea
4. Irritability
5. Vomiting, diarrhea and poor feeding.
# Sensitivity and Specificity of Symptoms for PCAP

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tachypnea</td>
<td>92%</td>
<td>15%</td>
</tr>
<tr>
<td>Cough</td>
<td>92%</td>
<td>19%</td>
</tr>
<tr>
<td>Toxic appearance</td>
<td>81%</td>
<td>60%</td>
</tr>
<tr>
<td>Crackles</td>
<td>44%</td>
<td>80%</td>
</tr>
<tr>
<td>Retractions</td>
<td>35%</td>
<td>82%</td>
</tr>
<tr>
<td>Flaring</td>
<td>35%</td>
<td>82%</td>
</tr>
<tr>
<td>Pallor</td>
<td>35%</td>
<td>87%</td>
</tr>
<tr>
<td>Grunting</td>
<td>19%</td>
<td>94%</td>
</tr>
</tbody>
</table>

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# Indications for Admission in PCAP

**Signs and symptoms**
- Dyspnea
- Hypotension
- Lethargy
- Tachypnea
- Vomiting

**Grunting**
- Retractions
- Toxic appearance

**Social factors**
- Poor follow-up
- Poor home care
- Neonate

**Progression**
- Rapid progression
- Failed outpatient therapy
- Complications

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# Initial Empirical Treatment of PCAP Based on Age and Severity of Pneumonia

<table>
<thead>
<tr>
<th>Age</th>
<th>Outpatients (Mild to Moderate)</th>
<th>Inpatients (Moderate)</th>
<th>Inpatients (Severe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3–6 mo</td>
<td>Amoxicillin with or without clavulanate Erythromycin</td>
<td>Ceftriaxone or cefotaxime</td>
<td>Ceftriaxone or Cefotaxime ± vancomycin</td>
</tr>
<tr>
<td>6 mo to 5 yr</td>
<td>Amoxicillin with or without clavulanate Macrolide</td>
<td>Ceftriaxone, Cefotaxime, or Cefuroxime ± macrolide</td>
<td>Ceftriaxone or Cefotaxime ± macrolide ± vancomycin</td>
</tr>
<tr>
<td>5–18 yr</td>
<td>Macrolide</td>
<td>Ceftriaxone or Cefotaxime ± macrolide</td>
<td>Ceftriaxone or Cefotaxime ± macrolide ± vancomycin</td>
</tr>
</tbody>
</table>

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A chest radiograph should be obtained if:

1. the diagnosis is questionable
2. this is a repeated episode
3. the patient is ill enough to be admitted
4. the child is younger than 3 years and
   - has a fever > 39°C without a source and
   - leukocytosis > 15,000 mm³
5. a complicated pneumonia is suspected
### Pediatric CAP

**Possible Pathogen** | **Empiric Therapy**
--- | ---
Mild, Nontoxic pharyngitis, rhinorrhea or diarrhea | Probably viral | None
Moderate toxicity no hospitalization | S pneumoniae, S pyogenes, H influenzae, M pneumoniae, Influenza A and B | Amoxicillin, Co-amoxiclav, Cefprozil, Cefdinir, Cefpodoxime, Cefuroxime, Ceftriaxone, Macrolide
Lobar or segmental consolidation, mild | S pneumoniae, S pyogenes, S aureus, M pneumoniae, H influenzae, M pneumoniae | Cefuroxime, ceftriaxone, Nafcillin, oxacillin, ceftazolin, clindamycin, Macrolide


### Pediatric CAP

**Possible Pathogen** | **Empiric Therapy**
--- | ---
Bilateral, severe | S pneumoniae | Cefuroxime, ceftriaxone
Lobar or segmental consolidation, moderate - severe | S pneumoniae, S pyogenes, S aureus, M pneumoniae | Cefuroxime, ceftriaxone, Nafcillin, oxacillin, ceftazolin, clindamycin, Macrolide
With pleural fluid, empyema or necrotizing | S pneumoniae, S pyogenes, S aureus, H influenzae, Anaerobe | Ceftriaxone, cefotaxime, Nafcillin, oxacillin, ceftazolin, clindamycin, Vancomycin, Meropenem, imipenem, BL-BI


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### Predictors of Mortality in Community Acquired Pneumonia in Children

Maria Liza B. Zabala and Alexander O. Tuazon. UP-PGH 2001

<table>
<thead>
<tr>
<th>Variable</th>
<th>Survivor</th>
<th>Mortality</th>
<th>p</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-existing illness</td>
<td>27/74</td>
<td>32/46</td>
<td>0.0004</td>
<td>3.98</td>
<td>1.68-9.54</td>
</tr>
<tr>
<td>Temp 38.5</td>
<td>27/74</td>
<td>26/46</td>
<td>0.009</td>
<td>2.26</td>
<td>1-5.15</td>
</tr>
<tr>
<td>Altered mental status</td>
<td>60/74</td>
<td>45/46</td>
<td>0.007</td>
<td>10.5</td>
<td>1.47-453.64</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>20/74</td>
<td>46/46</td>
<td>0.0000</td>
<td>0</td>
<td>0.017-231.5</td>
</tr>
<tr>
<td>O2 supplementation</td>
<td>46/74</td>
<td>46/46</td>
<td>0.0000</td>
<td>0</td>
<td>0.017-231.5</td>
</tr>
</tbody>
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### Predictors of Mortality in Community Acquired Pneumonia in Children

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<th>Variable</th>
<th>Survivor</th>
<th>Mortality</th>
<th>p</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin (m+SD)</td>
<td>111 ± 20</td>
<td>94 ± 28</td>
<td>0.0002</td>
<td>9.47-9.54</td>
<td></td>
</tr>
<tr>
<td>WBC &lt; 5 x 10^9/L</td>
<td>1/74</td>
<td>7/43</td>
<td>0.002</td>
<td>15.37</td>
<td>1.9-690.98</td>
</tr>
<tr>
<td>WBC &gt; 28 x 10^9/L</td>
<td>6/74</td>
<td>7/43</td>
<td>0.033</td>
<td>3.15</td>
<td>0.94-11.33</td>
</tr>
<tr>
<td>Platelet &lt; 150 x 10^9/mm^3</td>
<td>5/70</td>
<td>15/43</td>
<td>0.0003</td>
<td>6.5</td>
<td>1.98-24.6</td>
</tr>
</tbody>
</table>
### Complications of PCAP

**Viral PCAP**
- Focal necrosis and airway plugging
- Atelectasis
- Bronchospasm
- Apnea spells
- Respiratory failure
- ARDS
- Reactive airway disease
- Bronchiectasis
- Bronchiolitis obliterans
- Pulmonary fibrosis

**Bacterial PCAP**
- Most commonly associated with *S. pneumoniae* in children younger than 2 years
  - Meningitis
  - Purpura fulminans
  - Arthritis
  - Parapneumonic effusions
  - Empyema
  - Abscess formation
  - Endocarditis
  - Pericarditis

### Comparison of children admitted for Pneumococcal Pneumonia (Jerusalem)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Pulmonary complications</th>
<th>No pulmonary complications</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>3.4 ± 3.2</td>
<td>4.0 ± 4.0</td>
<td>NS</td>
</tr>
<tr>
<td>M/F ratio</td>
<td>1.49</td>
<td>1.76</td>
<td>NS</td>
</tr>
<tr>
<td>Background disease (%)</td>
<td>50.0</td>
<td>45.5</td>
<td>NS</td>
</tr>
<tr>
<td>Respiratory distress (%)</td>
<td>53.3</td>
<td>21.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Weight ≤10% for age (%)</td>
<td>56.4</td>
<td>33.8</td>
<td>0.018</td>
</tr>
<tr>
<td>Hemoglobin, admission (g/dL)</td>
<td>10.72 ± 1.30</td>
<td>11.12 ± 1.52</td>
<td>0.012</td>
</tr>
<tr>
<td>Hemoglobin, lowest (g/dL)</td>
<td>9.70 ± 1.30</td>
<td>10.69 ± 1.53</td>
<td>0.0001</td>
</tr>
<tr>
<td>Anemia age-adjusted (%)</td>
<td>69.0</td>
<td>43.3</td>
<td>0.014</td>
</tr>
<tr>
<td>Abnormal pleural fluid (%)</td>
<td>36.3</td>
<td>26.1</td>
<td>NS</td>
</tr>
<tr>
<td>Admission WBC ≤15,000 (%)</td>
<td>49.9</td>
<td>25.6</td>
<td>0.007</td>
</tr>
<tr>
<td>Days to defervescence (mean)</td>
<td>9.3 ± 1.0</td>
<td>9.3 ± 1.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Hospitalization days (mean)</td>
<td>13.2 ± 1.3</td>
<td>53 ± 37</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Resistance S pneumonia (%)</td>
<td>18.4</td>
<td>14.5</td>
<td>NS</td>
</tr>
</tbody>
</table>

Complications Of Pneumonia

Practical Management

- Prompt diagnosis and treatment of lung infections are necessary to prevent complications.
- Patient education enhances early medical consult.
- Compliance to treatment of lung infections is crucial in the prevention of complications.
- In the absence of these elements, complications of lung infections eventually develop.

Complications Of Pneumonia

Practical Management

- Lung Abscess
- Pleural Effusion and Empyema
- Pneumothorax

SB 12 y/o female with cough and low grade fever for 2 weeks. Consulted given Amoxicillin. Came to you for consultation because she developed high grade fever and cough productive of purulent foul-smelling sputum 2 days ago.

PE: HR 120 RR 32 T 39.5 C: Equal chest expansion, (+) subcostal retractions, (+) crackles over both lung fields
Lung Abscess

- A circumscribed, thick-walled cavity in the lung that contains purulent material resulting from suppuration and necrosis of the involved lung parenchyma.
- An unresolved area of pneumonia is the site in which an abscess develops most frequently.
- Pulmonary aspiration, diminished clearance mechanisms, embolic phenomena, hematogenous spread from septicemia, or local extension from oropharyngeal or abdominal processes contribute to abscess development.
- Abscess may develop indolently over a few weeks with tachypnea, cough and fever.

Lung Abscess: Organisms

Common anaerobes:
- *Fusobacterium nucleatum*
- *Prevotella melaninogenica*
- *Bacteroides fragilis* group
- *Bacteroides urealyticus* group
- *Peptostreptococcus* species
- *Veillonella* species
- *Microaerophilis streptococci*
- *Porphyromonas*
- *Prevotella oralis* group

Common aerobes:
- *S. aureus*
- *E. coli*
- *Klebsiella pneumoniae*
- *Pseudomonas aeruginosa*
- *S. pyogenes*
- Group B *Streptococcus*

Lung Abscess: Evaluation

- Common Signs and Symptoms:
  
  Fever, pleuritic chest pain, cough, hemoptysis, dyspnea, sputum production, weight loss, malaise

- Physical Examination:
  
  Tachypnea, tachycardia, retractions, decreased chest movement, decreased breath sounds, dullness to percussion, crackles, bronchial breathing
Lung abscess in children.

Symptoms (%)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>83</td>
<td>94</td>
<td>100</td>
<td>91</td>
</tr>
<tr>
<td>Cough</td>
<td>65</td>
<td>53</td>
<td>87</td>
<td>87</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>36</td>
<td>26</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>Chest pain</td>
<td>31</td>
<td>24</td>
<td>22</td>
<td>9</td>
</tr>
<tr>
<td>Anorexia/ Nausea and Vomiting</td>
<td>24</td>
<td>20</td>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td>Malaise and Lethargy</td>
<td>31</td>
<td>11</td>
<td>NR</td>
<td>22</td>
</tr>
</tbody>
</table>

Diagnosis:
Chest X-Ray: solitary, thick-walled cavity in the lung with or without air fluid level
Ultrasonography and CT scan: to localize the lesion and guide drainage or needle aspiration.
Direct percutaneous aspiration is the most reliable mode of identification of the etiologic agent.

Lung Abscess: Antimicrobial Treatment

- Overall outcome is good, with mortality rates lower than those in adults.
- Up to 90% of patients with lung abscess may be adequately treated with intravenous antibiotic therapy.
- The choice of antibiotic is usually empiric based on the underlying condition of the patient and the presumed etiologic agent(s).
- The duration of parenteral treatment varies from 5 days (Patradoo-Ho 2007) to 3 weeks (Tan 1995), followed by oral therapy.

Lung Abscess: Surgical Treatment

- Surgical management is considered in cases of large lung abscess especially when associated with hemoptysis.
- Surgical management is indicated if there is clinical deterioration despite appropriate antibiotic therapy.

1. Drainage via bronchoscopy
2. Percutaneous tube drainage
3. Percutaneous needle aspiration
4. Lobectomy

Lobectomy or wedge resection should be reserved for massive expansion of the abscess associated with mediastinal shift and attendant symptoms.
MT a 5 y/o male with high-grade fever and dyspnea. 1 month PTA, he developed cough with low grade fever on-and–off. 2 weeks PTA, consulted with a private physician and was given Amoxicillin and carbocisteine with no relief. 2 days PTA, fever became high grade w/ progressive dyspnea.

PE: HR 120  RR 48  T 39.1 C; (+) multiple CLAD (+) chest lag on the left, (+) decreased breath sounds and vocal fremitus ,left (+) dullness to percussion left, (-) crackles, (-) wheezing

Pleural Effusion and Empyema

- Collection of fluid or pus in the pleural space
- Can occur as a complication of pneumonia, tuberculosis or surgical procedures (post-surgical empyema)
- *Staphylococcus aureus* is the single most common pathogen of empyema in infants < 2 years of age
- Other common nontuberculous causes of empyema include *H. influenzae* type B, *S. pyogenes, D. pneumoniae, E. coli, Klebsiella sp, Pseudomonas aeruginosa.*

Pleural Effusion and Empyema

- The diagnosis of empyema include CXR, ultrasound and examination of pleural fluid
- Obliteration of the costophrenic sulcus is the earliest radiologic sign of pleural fluid accumulation
- Failure of the liquid to shift from upright to decubitus view indicates loculation as commonly seen in staphylococcal empyema

Pleural Effusion and Empyema

Physical examination findings:
- Tachypnea
- Fever
- Chills, Cough
- Irritability, Anorexia, Lethargy
- Chest pain, Chest tightness
- Diminished thoracic excursion
- Fullness of the intercostal spaces, Dull or flat percussion
- Decreased tactile and vocal fremiti
- Displaced trachea and cardiac apex
Pleural Effusion and Empyema

- Expectoration of an increasing amount of purulent sputum with or without hemoptysis may herald the onset of bronchopleural fistula and pyopneumothorax
- Bronchopleural fistula may be due to rupture of neglected empyema into the lung or rupture of pulmonary suppuration into the pleura
- Muffling of the heart tones and pericardial rub indicate extension into the pericardium

Pleural Effusion and Empyema: Treatment

- Outcome is uniformly good, regardless of treatment option
- Treatment is aimed at specific management of the underlying cause and relief of functional disturbances caused by the existing clinical disorder, pleural involvement and concurrent complications
- The basic principle for treatment is to drain the infected pleural space and allow lung re-expansion
- Treatment is medical (high dose intravenous antibiotics) and surgical

Pleural Effusion and Empyema: Treatment

- General supportive measures:
  1. Bed rest
  2. Analgesia
  3. Fluid replacement
  4. Supplemental oxygen
  5. Lying on the affected side
- Choice of antimicrobial is based on bacterial epidemiology in the community, clinical data, pharmacologic properties of the drug.
- Repeated thoracentesis and eventually continuous chest tube drainage are indicated if rapid re-accumulation of effusion induces dyspnea.

Pleural Effusion and Empyema: Antibiotics

- Little difference in penetration of penicillins and cephalosporins into empyemas and uninfected parapneumonic fluids.
- Drugs with excellent pleural penetration include aztreonam, clindamycin, ciprofloxacin, cephalothin and penicillin
- Aminoglycosides may be inactivated or have poor penetration into empyemas than uncomplicated parapneumonic effusions.
Pleural Effusion and Empyema: Treatment

Indications for tube thoracostomy:
1. Identification of an organism by gram stain
2. Positive pleural fluid culture
3. Pleural fluid glucose < 40 mg/dl
4. Pleural fluid LDH > 1000 IU
5. Pleural fluid pH < 7.10
6. Frank pus

An advanced stage empyema is suspected with pleural fluid that has:
1. Pure pus
2. pH < 7.0
3. LDH > 1000 U/mL
4. Glucose < 40 mg/dL
5. Bacteria on gram stain

Pleural Effusion and Empyema: Treatment

- Therapy includes high dose intravenous antibiotics and drainage. Other modalities include fibrinolytic therapy, surgical debridement (including VATS).
- Surgical intervention may be considered in patients with evidence of treatment failure manifest as persistent leukocytosis, elevated ESR or C-reactive protein, persistence of significant pleural fluid on radiographic chest imaging.
- Decortication represents the primary surgical intervention.

ACCP classification of parapneumonic effusions

<table>
<thead>
<tr>
<th>Pleural space anatomy</th>
<th>Pleural fluid microbiology</th>
<th>Pleural fluid chemistry</th>
<th>Category</th>
<th>Risk of Poor Outcome</th>
<th>Drainage</th>
<th>Additional fibrinolytic, VATS or surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal, free-flowing effusion (&lt;10 mm on lateral decubitus CXR)</td>
<td>Unknown</td>
<td>pH unknown</td>
<td>1</td>
<td>Very Low</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Small-moderate free-flowing effusion (&gt;10 mm, &lt;1/2 hemithorax)</td>
<td>Negative</td>
<td>pH &gt; 7.2</td>
<td>2</td>
<td>Low</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Large, free-flowing (&gt;1/2 hemithorax), loculated effusion or effusion with thickened pleura</td>
<td>Positive culture and gram stain</td>
<td>pH &lt; 7.2</td>
<td>3</td>
<td>Moderate</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Pus</td>
<td>4</td>
<td>High</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Classification</th>
<th>Characteristics</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>Clear, slightly cloudy, serous sterile fluid Has at least one of the following: pH &lt; 7.20 Glucose &lt; 40 mg/dL LDH &gt; 1000 IU/dL Protein &gt; 2.5 g/dL Specific gravity &gt; 1.018 WBC &gt; 500/mm³</td>
<td>Antibiotics with or without chest tube drainage</td>
</tr>
<tr>
<td>Fibropurulent</td>
<td>Fluid is thicker and opaque, or Positive culture</td>
<td>Antibiotics with chest tube drainage</td>
</tr>
<tr>
<td>Chronic</td>
<td>A peel forms around the lung</td>
<td>Decortication</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classification</th>
<th>Success</th>
<th>Decortication</th>
<th>Hospitalization</th>
<th>Fever after drainage</th>
<th>Tube insertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>34/42 (81%)</td>
<td>8/42 (19%)</td>
<td>22.4 ± 6.6 d</td>
<td>9.2 ± 6.6 d</td>
<td>7.6 ± 5.6 d</td>
</tr>
<tr>
<td>Fibropurulent</td>
<td>15/17 (88%)</td>
<td>2/17 (12%)</td>
<td>30.1 ± 11.5 d</td>
<td>10.0 ± 4.0 d</td>
<td>12.8 ± 9.3 d</td>
</tr>
<tr>
<td>Chronic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pneumothorax

- An accumulation of air in the pleural spaces due to secondary to free communication of the pleural space with the atmosphere either from a chest wall defect through the parietal pleura or from alveolar rupture
- Can be secondary to infection with gas-producing microorganisms.

3 factors that determine the extent of alveolar rupture:
1. Degree of transpulmonary pressure exerted
2. Duration of pressure applied
3. Ratio of inexpressible to expansible portion of the lung

Pneumothorax

- Signs and symptoms may vary according to the extent of lung collapse, degree of intrapleural pressure, rapidity of onset and age and respiratory reserve of the patient
- PE includes chest bulging on the affected side if one side is involved, shift of cardiac impulse away from the site of the pneumothorax, tachypnea, decreased breath sounds on the affected side, tachycardia
- Grunting, retraction and cyanosis occur late in the progression of the complication

FC, 3 y/o male w/ 2-week-history of cough & low-grade fever productive of whitish phlegm. 9 days ago consulted at a local hospital, chest x-ray done showed pleural effusion left. Given oral Cefuroxime. Few hours PTA suddenly became dyspneic and was rushed to the ER. PE: HR 140 RR 50 T 37.9 C Trachea deviated to the right (+) chest lag, left (+) decreased breath sounds left lung field, hyperresonant on percussion, left chest; Apical heart sounds heard on the right
Pneumothorax

- Differential diagnosis include lung cyst, lobar emphysema, bullae, diaphragmatic hernia
- CXR is crucial in the confirmation of diagnosis
- Effective management requires early clinical recognition and prompt radiologic investigation
- Therapeutic management should take into account clinical severity, presence and nature of the underlying lung disease, precipitating event and history of recurrence

Pneumothorax

- Direct mechanical evacuation of intrapleural air should be performed unless the size of the pneumothorax is very small, the underlying disorder is mild and the clinical status is stable
- Close clinical and blood gas monitoring are integral parts of the management in all situations.

Summary

Complications of lung infections such as lung abscess, empyema and pneumothorax require a high index of clinical suspicion and confirmation by employing the appropriate diagnostic testing.

Management of these infections includes prescription of appropriate antimicrobials and may require specific drainage procedures and the judicial use of surgical interventions.