Objectives:

By the end of this lecture, the participant should be able to...

1. Understand the epidemiology of Tuberculosis
2. Explain the pathophysiology of Tuberculosis
3. List risk factor for tuberculosis
4. Explain the current screening process for tuberculosis
5. Understand and explain the need for continued tuberculosis and prevention

CASE

You receive a call to respond to a local housing project for a 30-year-old male complaining of difficulty breathing. On arrival to the house you find a man sitting in a one-room apartment with his family attending him. The patient is diaphoretic and coughing continuously. Family states the patient just moved here from Asia and they do not know his medical history. Vital signs are stable and the patient is maintaining his airway.

Do you have any concerns?

YES!

Introduction

- Tuberculosis is still a leading cause of death worldwide
- According to the CDC
  - TB continues to be reported in every state
  - Drug-resistant cases reported in almost every state
  - Estimated 10-15 million persons in the U.S. are infected with *M. tuberculosis*
  - Without intervention, about 10% of infected patients will develop TB disease at some point in life

References

Epidemiology

- Tuberculosis is considered the leading cause of death in HIV patients world-wide
- Tuberculosis is considered an AIDS defining opportunistic infection
- 99% of the two million deaths, and 95% of the eight million new cases are occurring in middle to low income countries

References

US Statistics

- In 1953 there were 84,304 cases of tuberculosis reported with 19,707 deaths from tuberculosis
- In the year 2000 there were 16,377 cases reported and 751 deaths reported
References


The resurgence of Tuberculosis in the United States
- From 1985-1992 cases of tuberculosis in the united states rose 20%
- Incidence of the disease rose to 10.5 cases per 100,000 population by 1992
- Three main reason can be given credit for the resurgence of Tuberculosis worldwide
  1. In the 1970’s, funding was decreased for TB education and prevention
  2. Drug resistance
  3. Decreasing immunity due to the human immunodeficiency virus
 Also contributing are
- Congregated living areas
- Immigration
- Prisons and shelters
Multi-Drug resistance

- It is a world wide problem
- Multi-drug resistance began when patients were not treated effectively and became chronic carriers spreading the multi-drug resistant strain of tuberculosis
- Patients are resistant to two commonly used drugs; isoniazid and rifampin
- Treatment is difficult with increasing medication costs

Pathophysiology of Tuberculosis

- Causative organism is *Mycobacterium tuberculosis*
- Weakly gram-positive obligate aerobic rod with acid fast staining properties
- Organism can multiply once every 12-24 hours
Transmission

- *Mycobacterium Tuberculosis*’ primary route of transmission is the respiratory tract
- Patients with active tuberculosis can expel liquid droplets that aerosolize when the patient coughs, sneezes or even speaks
- Transmission can take place with a minimal amount of inhaled bacilli
- Inanimate objects such as furniture, utensils and cloths do not transfer the disease
- Mycobacterium tuberculosis organism is susceptible to ultraviolet light
- Transmission rarely occurs outdoors due to dilution of the organism
- The transmission risk increases in patients who have lung disease such as asthma, COPD, and emphysema
- Forms of extrapulmonary tuberculosis can also be infectious
- There is a case report of a health care worker who was infected while irrigating an abscess
- It is believed that irrigation caused aerosolization of the bacteria

References

Pathophysiology Continued

- Once the droplets enter the lungs they deposit in the mid lower lung zones on the surface of the alveoli
- Now begins the immunologic process (the body’s defense mechanism)
- Once at the alveoli level the tubercle bacilli begin to be phagocytized by the macrophage cells
- In a patient with an intact immune system they are able to kill the bacillus, decreasing the chance of infection
- If a more virulent bacillus is present, the macrophage may not be able to destroy the bacillus leading to infection
- In the impaired host the macrophage cells are unable to kill the bacillus
- Now the tubercle bacilli begins to replicate within the macrophage
• This process continues until the macrophage breaks apart
• During the process the body begins to send more cells to assist in the clean up process
• Monocytes are attracted to the site but do not have the ability to kill the bacilli
• The infected macrophage may be transported throughout the body through the lymphatic system
• The areas that attract the macrophage with the bacilli are areas of high oxygen concentration, such as kidneys, bones, brain and apical portion of the lungs
• This spread is usually asymptomatic but produces metastatic foci throughout the body which may become active at a later date
• Most patients are able to produce an effective immune response
• T lymphocytes are activated and are able to control the infection with in 2-10 weeks
• The lymphocyte activation causes the patient to have a positive tuberculin skin test

**Immunocompromised Patient**
• These patient do not always develop a cellular immunity and may not have a positive tuberculin skin test
• Tuberculosis in these patient can progress rapidly leading to death
• If the disease is dormant, and the patient’s immune status deteriorates, they will have an increased risk of reactivation
• About 10% of tuberculosis cases will reactivate
• A high number of these cases are patients with impaired immunity
• Conditions associated with an increased conversion rate
  1. AIDS (Acquired Immune Deficiency Syndrome)
  2. Immunosuppressive therapy (transplant and chemotherapy patients)
  3. Diabetes
  4. Malnutrition
  5. Malignant disease

**References**
**Groups at risk for tuberculosis**

<table>
<thead>
<tr>
<th>Groups at High Risk for Tuberculosis</th>
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</thead>
<tbody>
<tr>
<td>Persons with recent <em>Mycobacterium tuberculosis</em> infection (within the past 2 years) or a history of inadequately treated tuberculosis</td>
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<tr>
<td>Close contacts (i.e., those sharing the same household or other enclosed environments) of persons known or suspected to have tuberculosis</td>
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<td>Persons infected with the human immunodeficiency virus</td>
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<td>Persons who inject illicit drugs or use locally identified high-risk substances (e.g., crack cocaine)</td>
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<td>Residents and employees of high-risk congregated setting (e.g., correctional institutions, nursing homes, mental institutions or shelters for the homeless)</td>
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<td>Health care workers who serve high-risk clients</td>
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<td>Foreign-born persons, including children, who have recently arrived (within 5 years) from countries that have a high incidence</td>
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<td>Medically underserved, low-income populations</td>
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<tr>
<td>High-risk racial or ethnic minority populations, as defined locally</td>
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<tr>
<td>Elderly persons</td>
</tr>
<tr>
<td>Children less than 4 years of age, or infants, children and adolescents who have been exposed to adults in high-risk categories</td>
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<tr>
<td>Persons with medical conditions known to increase the risk of tuberculosis</td>
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<tr>
<td>Chest radiograph findings suggestive of previous tuberculosis in a person who received inadequate treatment or no treatment</td>
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<tr>
<td>Diabetes mellitus</td>
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<tr>
<td>Silicosis</td>
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<tr>
<td>Organ transplantation</td>
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<tr>
<td>Prolong corticosteroid therapy (e.g., prednisone in a dosage of 15mg or more per day for 1 month or more)</td>
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<td>Other immunosuppressive therapy</td>
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<td>Cancer of the head or neck</td>
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<td>Hematologic and reticuloendothelial disease (e.g., leukemia and lymphoma)</td>
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<tr>
<td>End-stage renal disease</td>
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<tr>
<td>Intestinal bypass or gastrectomy</td>
</tr>
<tr>
<td>Chronic malabsorption syndromes</td>
</tr>
<tr>
<td>Weight that is 10 percent or more below ideal body weight</td>
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Medical History
- You are the first line and the history you obtain will only enhance the patient care and outcome.

Key Questions
- Has the patient ever been treated for tuberculosis
- Any exposure to another patient with tuberculosis
- Past medical history including HIV status, Hepatitis, and immunosuppressive therapy
- What is the demographic location of the patient

Sign and Symptoms
- Cough, Hemoptysis
- Fever and night sweats
- Malaise
- Adenopathy
- Pleuritic Chest pain
- Appetite loss
- Chills

References

Diagnosis and Screening
TB skin Test
- Standard test for detecting infection with *M. tuberculosis*
- Intradermal administration of purified protein derivative read at 48-72 hours
- Positive reaction indicates presence of infection
- But not necessarily active disease
- Active disease is confirmed by culture
Testing for TB Disease and Infection

Administering the Tuberculin Skin Test

- Inject intradermally 0.1 ml of 5 TU PPD tuberculin
- Produce wheal 6 mm to 10 mm in diameter
- Do not recap, bend, or break needles, or remove needles from syringes
- Follow universal precautions for infection control

Reading the Tuberculin Skin Test

- Read reaction 48-72 hours after injection
- Measure only induration
- Record reaction in millimeters
Interpreting skin test

- True-positives vary with patients background

5mm induration is positive in patients with

- Known or suspected HIV
- An abnormal CXR
- Close contact with person with active TB

> 10 mm induration is positive in:

- Resident/employees of long term care facilities
- IV drug abusers
- Immigrants from an area with high incidence
- Certain minority groups (Hispanics, African-Americans, native Americans)

> 15 mm induration is positive in all others

Negative skin test does not completely exclude the diagnosis

- Especially in immunocompromised patients

The Two-Step Testing PPD

- Use two-step testing for patients that will be tested repeatedly
- If first test positive, consider the person infected
- If first test negative, give second test 1-3 weeks later
- If second test positive, consider person infected
- If second test negative, consider person uninfected

References


Sputum

- Sputum specimens are needed to confirm diagnosis
- Smears of sputum look for acid-fast bacilli (AFB)
- Smears usually ready in 24 hours
- Cultures will give definitive diagnosis and will be available 4-14 days
- Patients with positive AFB should be presumed to have tuberculosis
References

CXR findings
- Primary TB
- Small parenchymal infiltrates located in any area of lung and unilateral hilar adenopathy
- Lesions may calcify and form Ghon complex, Inflammatory infiltrates of the lower lobes
- Hilar adenopathy (lymph nodes near the heart) is radiographic hallmark of primary TB in children

Treatment
- As soon as the diagnosis is suspected, the patient should be put in respiratory isolation and wear an isolation mask
- With the onset of multi-drug resistant tuberculosis, a 4 drug regimen is recommend until sensitivity to antibiotics are confirmed
Current drug therapy
1. Isoniazid (INH)
2. Rifampin (RIF)
3. Pyrazinamide (PZA)
4. Ethambutol (EMB)
5. Streptomycin (SM)

- Tuberculosis drug therapy has multiple side affects and drug interactions that should be carefully monitored by the patients provider

BCG Vaccination (Bacillus Calmette-Guérin vaccine)
- Tuberculosis vaccine is a suspension of an attenuated strain (bacillus Calmette-Guérin) of Mycobacterium tuberculosis.
- It is a bovine type, which is inoculated into the skin for tuberculosis prophylaxis.
- Not recommended in immunization programs or TB control programs in the U.S.
- BCG vaccine is at times considered for infants and children who are continually exposed to untreated or ineffectively treated patients.

References

Occupational Hazards
What are they?
Do we as medical providers need to be concerned?
- You are the front line of emergency medicine
- You are the first exposed
- You are in a closed space with multiple patients daily

Data
- A study in a urban Emergency Department showed that in one year 12% of the emergency department staff converted on their PPD skin test
- Study was from 1994-1995
- Conversion rate through out the hospital was 2%
- Of the 12%, all where Registered nurses working in the emergency department
- In 1996, after instituting TB isolation and infection control, there were no PPD conversions in the ER.
- Infection control works!

References

More data
- A published report in Clinical Infectious Disease states
• Hospitals that had effective Tuberculosis infection control programs had a low incidence of employee conversion
• Study at an Atlanta Hospital involving 5773 Employees from 1994-1998 where studied
• All employees had TB skin tests
• 69 had document skin conversion 1.19%
• Infection rates did not change with the degree of patient contact
• People who tested positive lived in areas with high incidence of tuberculosis

Reference

**TB in Health Care Workers**
Studies show conflicting results. Some show increased risk of TB in the health care worker, some show decreased risk.
A 3-decade study looked at Finish health care workers

The data was collected from 1966-1995
56,146 patients 658 occupational cases of Tuberculosis
Over all risk for health care workers was considered less than the general public risk

Reference

**ER Detection of patients at risk**
Study looked at ER triage methods to assess the time of respiratory isolation for patients with possible tuberculosis
Admitted patients have had delay up to 6 days before isolation began
On average 75% of patients had a 24 hour delay in isolation
The study published in Annals of Emergency Medicine used (RIPT) Rapid Isolation of Pulmonary tuberculosis to screen patients with possible TB
The system looked at symptoms and risk factors and assigned them a point value
Scoring system was 0-24

**Results**
The screening tool was considered moderately successful in screening for TB
More studies are needed

Reference
What is happening now?
- Statistics in multiple states improving
- Renewed effort in screening and education on tuberculosis
- Key is to not make the same mistake twice and to not let our guard down
- In 2000 3.5 cases per 100,000 population in 22 states
- This is considered low incidence
- These 22 states accounted for only 11.9% of the national total TB cases.

Reference

So are you at risk?
A study published in the Annals of Emergency Medicine looked at New York City EMS workers. It found that despite a high incidence of tuberculosis in New York City, the conversion rate of EMS personnel was low compared to hospital-based health care workers.
Data collected from 1993-1996
A total of 7,290 PPD tests were read.
The average conversion rate over these four years was 0.5%

References

Conclusion
- With the proper precautions and education, EMS personnel will continue to be at low risk for tuberculosis.
- Be sure to follow all local and state protocols.
- Advocate for tuberculosis skin testing at your work place.