Bovine Tuberculosis

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Implications

• Bovine tuberculosis is a human health issue in many foreign countries where the milk is not pasteurized and there are high rates of human infection

• Bovine TB in Michigan is an economic issue!! Until the disease is eradicated from Michigan livestock, other states will continue to impose restrictions on the sale and movement of Michigan livestock
What is Tuberculosis?

- Tuberculosis (TB) is a contagious disease of both animals and humans.
- It is caused by *Mycobacterium*.
Mycobacterium

• Unique bacteria
• Cell walls contain a lot of waxy material (mycolic acid)
  – inhibits the uptake of nutrients into the bacterial cell
  – causes the cell to clump
    • these factors contribute to the slow growth rate
• Mycobacteria do not grow outside of a host except in cultured media
  – Slow growth rate
  – Multiply approximately once every 20 hours
Mycobacterium

- Require oxygen for growth
- Very heat sensitive
- Can be killed by a weak solution of common household bleach
  - (1 part bleach to 9 parts water)
- Can remain viable for extended periods of time in cold weather
Three Types of Tuberculosis

• *Mycobacterium bovis* (bovine)

• *Mycobacterium avium* (bird)

• *Mycobacterium tuberculosis*
Mycobacterium bovis

• Bovine TB can be transmitted from livestock to humans, deer and other animals

• No other organism has as great a host range as bovine TB

• Bovine TB can infect all warmblooded vertebrates
Mycobacterium avium

- Can affect all species of bird
- Can affect hogs and cattle
**Mycobacterium tuberculosis**

- Primarily affects humans
- Can be transmitted to hogs, cattle, and dogs
Bovine TB
TB Transmission

• Can be transmitted from animals to humans and vice versa
• Young animals and humans can contract the disease by drinking raw milk from infected dams
• Can be transmitted through saliva and other discharges of infected animals
• Most common means of transmission
  – RESPIRATION
Who is at risk?

• Animals kept in close contact with other infected animals in enclosed areas like barns are at greatest risk for exposure to bovine TB.
Animal Immune Response

- Immune system recognizes bacteria
- Inflammatory cells (macrophages) are sent to dispose of it
- *Mycobacterium* is resistant to destruction
  - once ingested by the macrophages it may replicate and kill the macrophage
Animal Immune Response

- Immune system continues to send macrophages to help destroy the bacteria
- Results in an accumulation of living and dead macrophages at the site of the bacteria
- Accumulation is called a tubercle
Animal Immune Response

- Thick capsule may form around the tubercle; called a granuloma

Pericardial granuloma
Diagnosing Bovine TB

For a complete explanation of on-farm testing procedures refer to the Bovine Tuberculosis Testing Procedures power point
Steps in Diagnosis

• The result of each on farm test determines if follow up tests are necessary

• Cattle suspected of being infected after CFT test and CCT test are submitted to an animal diagnostic laboratory for necropsy (animal autopsy)
  – gross examination
  – histological (microscopic) examination
• Upon submission animals are closely examined for gross lesions suggestive of bovine TB
• Lymph nodes are closely examined
• Multiple tissue samples are taken for histopathological examination

Infected Mesenteric lymph node
Gross Lesions

- Characteristic gross lesion of an animal infected with bovine TB is the presence of “tubercles” within the body
- A tubercle is a white nodule usually 1mm-2cm in diameter within a lymph node or organ
- Commonly found in the thoracic cavity
- May be found in the liver or other major organs
Gross Lesions

• Finding gross lesions is not conclusive evidence that the animal is infected with the disease

• Further testing is required

Lesions in the lungs of a 2 yr old heifer
Histopathology

- The tissue samples collected during the necropsy are examined for histopathological (microscopic) lesions.
- Most common lesion associated with bovine TB is the granuloma.
Acid Fast Staining

• Unique properties of the cell wall allow a special stain to be used

• This stain, called acid-fast stain, allows for bacteria to be visualized
Process

- Tissue is ground into small pieces
- Treated to destroy non-mycobacteria
- Concentrated by centrifugation
- Applied to microscope slide
- Slide is stained so that mycobacteria can be seen
Culture

- If the animal is suspected of being infected with bovine TB, attempts are made to grow *Mycobacterium bovis* from tissue samples collected during necropsy.
Process

- Culturing is performed under specific conditions that favor growth of the bacteria
- Culturing usually takes 8 to 16 weeks
Polymerase Chain Reaction (PCR)

- Used to detect the presence of DNA that is specific to the organism of interest
- PCR amplifies the specific portion of DNA
- This product can be easily visualized using standard laboratory procedures
- PCR is very sensitive
  - Can detect an organism even when present at very low levels
Polymerase Chain Reaction (PCR)

- PCR is used only on tissues that have histological evidence of bovine TB
- Results are available within seven days
- Positive results suggest that the animal is infected with TB
- Culturing confirms if the strain is bovine TB
Results

• A positive PCR along with other test results may be used to classify an animal as being infected with bovine TB
The Human Disease

• Individuals can be infected without knowing it
• Due to the slow growth rate disease usually takes months to develop
• Organism may lie dormant within a host’s body for its lifetime without causing progressive disease
• Infected humans who have not developed the active disease can be treated to prevent the disease from occurring
Method of Infection
Initial Infection

• Causative bacteria (this can include bovine TB) enter the body and settle in a clump on the host tissue
• Bacteria multiply for several weeks
• Body’s immune system recognizes their invasion and an immune response begins
Immune Response

• The immune response in humans is called “cell mediated”

• Cells of the lung begin to multiply to form a wall around the invading bacteria

• This takes on the shape of a small, swollen tube
  – known as a “tubercle”
Immune Response

- At this stage of infection the tubercle is commonly sealed off and transformed into scar tissue
- Bacteria become dormant
- No longer affect the body
- Human host can continue to live normally with one or several dormant tubercles
Immune Response

• As long as the immune system remains strong the infection may be controlled and usually does not spread
Weak Immune System

• Bacterial infection will grow and spread
• Tubercles break open, pus will flow out and infect other regions of the lung and body with bacilli
• When infection occurs again it begins to make holes in the lung
• Forms many more tubercles which develop into “cavities”, or pits in the lungs
• The pus from infected lungs is coughed up
  – often called “sputum”

• Anyone producing sputum from a tuberculous lung is considered infectious and may spread the disease to other people or animals
Active Tuberculosis

- Consumes the lungs
  - causes large lesions in the tissue which prevents the lungs from working properly
- Can eventually lead to death in an untreated individual
Human TB in Michigan

287 cases in 2000

- 286 (99.7%) *M. tuberculosis*
- 1 (0.3%) *M. bovis*

- 196 (68%) Indigenous cases
- 91 (32%) Foreign born

- 143 (50%) Outside Wayne County
- 144 (50%) Wayne County

- 115 (80%) of 144 City of Detroit
• The causative bovine TB bacteria was not related to the strain of bovine TB found in North East Michigan
• All cases of human TB have been treated