Tick-borne Diseases
Texas Nurse Practitioners
San Antonio Sept. 4-7, 2014
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Familiar Situation?
- Mom removed this from 4 y.o. son
  - Thinks it’s a tick
  - Wants you to act
- What should you do?
  1. Identify contents
  2. Review which diseases associated with it
  3. Develop treatment plan

Learning Objectives
- Goal: Improve tick-borne disease management
  - Early recognition of disease
  - Appropriate treatment
- Content
  - Review common US tick species
  - Review tick-borne illness
    - Presentation, lab eval, treatment

Conflict of Interest Disclosure:
President of Partnership for Healing and Health, Ltd.
Provider of continuing medical education courses on tick-borne diseases

Common Hard Tick Vectors
- 9 Ticks
  - Ixodes
    - I. scapularis, I. pacificus, I. cookie
    - Eastern blacklegged, Western blacklegged, Groundhog
  - Dermacentor
    - D. variabilis, D. andersoni, D. occidentalis
    - American Dog, Rocky Mountain Wood, Pacific coast
  - Amblyomma
    - A. americanum, A. maculatum
    - Lone Star, Gulf Coast
  - Rhipicephalus sanguineus
    - Brown dog tick

Tick Identification
- Appearance
- Range
  - Travel history important

16 Tick-transmitted Diseases
- Anaplasmosis
- Ehrlichia muris-like
- Ehrlichiosis
- Babesiosis
- Borrelia miyamotoi
- STARI
- Rocky Mountain spotted fever
- Rickettsia parkeri rickettsiosis
- Bartonellosis
- Lyme disease
- Tularemia
- 364D rickettsiosis
- Colorado tick fever
- Q fever
- Heartland virus
- Powassan disease
- Rocky Mountain spotted fever
- Rickettsia parkeri rickettsiosis
- Bartonellosis

Photos courtesy of CDC
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Tick Ranges: US

East Black
West Black
American Dog
Rocky Mountain
Wood
Pacific coast
Lone Star
Gulf Coast
Brown dog

Tick Ranges: Texas

5 tick species
- 4 concentrated in east TX
  - Eastern blacklegged
  - American Dog
  - Lone Star
  - Gulf Coast
- Brown dog throughout

Lone Star Tick

Amblyomma americanum

Transmits
- Tularemia
- Heartland virus
- HME – human monocytic ehrlichiosis
- STARI – southern tick-associated rash illness

Black-legged Ticks

Ixodes scapularis,
I. pacificus, I. cookie

Diseases vary by species

<table>
<thead>
<tr>
<th>Tick Species</th>
<th>Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ixodes scapularis</em></td>
<td>Lyme, Anaplasmosis, Babesiosis, Ehrlichia microti-like disease, Powassan encephalitis, E. miyamotoi disease, Bartonellosis</td>
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<tr>
<td><em>Ixodes pacificus</em></td>
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<td><em>Ixodes cookie</em></td>
<td>Powassan encephalitis</td>
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American Dog Tick

Dermacentor variabilis

Transmits
- Tularemia
- Rocky Mountain Spotted Fever

James Gathany
Transmits
- Tularemia
- Rocky Mountain Spotted Fever

http://www.cdc.gov/ticks/geographic_distribution.html
Tick-borne Diseases

- Tick-borne disease (TBD)
  - Includes all tick-transmitted diseases
  - Co-infections
    - Subset of TBD
    - Pathogens transmitted by Eastern blacklegged tick
  - Potential of other TBD complicate
    - Diagnosis: overlapping symptoms altering presentations when multiple present
    - Treatment: may require antibiotic combinations apparent failure due to undiagnosed TBD

<table>
<thead>
<tr>
<th>Disease</th>
<th>Vector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyme</td>
<td>Eastern, Western blacklegged</td>
</tr>
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<tr>
<td>Tularemia</td>
<td>Lone star, Rocky Mountain wood, American dog</td>
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Rocky Mountain Spotted Fever

- Rickettsia rickettsi

- Very severe illness; most hospitalized
  - Incubation: 1-2 weeks

- Bacterium invades endothelial cells
  - Vascular leaks; subsequent exhaustion of clotting ability
  - Organ failure and tissue necrosis

- Symptoms
  - Early: sudden onset of fever, nausea, vomiting, muscle pain, lack of appetite
    - Adults: severe headache (universal); photophobia
    - Kids: abd. pain, altered mental status, injected conjunctiva

- Rash
  - 2-4 days after fever onset
    - Pink macules on the ankles, wrists, or forearms
      - 90% of kids
      - 10% of all pts have no rash
    - Classic petechial rash: 5-6 days
      - 35-60%; indicates severe disease

- Lab findings
  - Acute: No readily available tests
  - Culture: specialized laboratories
  - PCR or immunohistochemical (IHC) staining of rash biopsy
  - Confirmatory: acute and convalescent IgG IFA titers

- Treatment: Doxycycline* 100mg twice daily
  - Begin when RMSF first suspected
  - Optimum duration unknown; usually 7-14 days
  - Continue at least 3 days beyond fever cessation
    - Usual fever gone within 72 hours

- Long-term sequelae
  - If vasculitis: expect end-organ damage, tissue necrosis
    - Profound neurological deficits, diminishes renal function, amputations
  - No vasculitis: full recovery within days to months.

* Short courses of doxycycline safe for all children.
Human Monocytic Ehrlichiosis — *Ehrlichia chaffeensis*

- Potentially serious infection
  - 2-3% mortality
  - Incubation: 1-2 weeks
  - Location: SE and south-central states
- Bacterium invades monocytes
- Symptoms
  - Chills, fever, headache, muscle aches
  - Nausea
  - Fine petechial rash
  - 66% of kids, 30% of adults

- Treatment: Doxycycline 100mg twice daily
  - Begin when disease first suspected
  - Optimum duration unknown; usually 7-14 days
  - Continue at least 3 days beyond fever cessation
  - Usually fever gone within 72 hours

- Long-term sequelae
  - Usually none

Lab findings
- Direct evidence
  - Acute: Morulae in monocytes
    - Seen in 20% in first week
    - Culture: specialized laboratories
    - 85% have neg IFA titer in first 10 days
  - Confirmatory
    - PCR: acute and convalescent titers
- Indirect
  - Low WBC count, low platelets, elevated liver enzymes

Clinical diagnosis

Human Ewingii Ehrlichiosis — *Ehrlichia chaffeensis*

- Invades PMNs, otherwise very similar to HME

Lab findings
- Direct evidence
  - Acute: Morulae in PMNs
    - Seen in 20% in first week
    - Culture: specialized laboratories
  - 85% have neg IFA titer in first 10 days
- Confirmatory
  - PCR: acute and convalescent titers

Clinical diagnosis

Anaplasmosis — *Anaplasma phagocytophilum*

- Potentially serious infection
  - < 1% mortality
  - Incubation: 1-2 weeks
  - Location: Midwest, northeast
  - Transfusion-related cases
- Bacterium invades PMNs
- Symptoms
  - Chills, fever, headache, muscle aches, nausea, abdominal pain, cough, confusion
  - Rash in < 1%

- Treatment: Doxycycline 100mg twice daily
  - Begin when HGA first suspected
  - Optimum duration unknown; usually 7-14 days
  - Continue at least 3 days beyond fever cessation
  - Usually fever gone within 72 hours

Lab findings
- Direct evidence
  - Acute: Morulae in PMNs
    - Seen in 20% in first week
    - Culture: specialized laboratories
    - 85% have neg IFA titer in first 10 days
  - Confirmatory
    - PCR: acute and convalescent titers

Clinical diagnosis
Babesiosis

— Babesia microti, B. duncani, B. divergens

- Potentially serious infection
  - Mortality in immunocompromised
  - Incubation: weeks - months
  - Location: Midwest, northeast
  - Acute and chronic disease:
    - also transfusion-related and congenital cases
- Parasitizes red blood cells (RBCs)
  - Form varies by life-stage
- Symptoms
  - Malaria-like: fever, chills, sweats, muscle pain, joint pain, anorexia, nausea, vomiting

Findings

- Splenomegaly, hepatomegaly, jaundice.

Lab findings

- Direct evidence
  - blood smear
  - serology
    - few strain-specific
  - PCR, FISH (?)
- Indirect evidence
  - Results consistent with hemolytic anemia
  - Eosinophilia

Treatment

- Based on observational, not trial data
- 7 day minimum of
  - Atovaquone 750 mg po BID + Azithromycin: 500 – 1000mg day 1, then 250 -1000 daily or Clindamycin 600 mg po TID + quinine 650 mg po TID
- Other potentially useful agents
  - Atovaquone/proguanicil (Malarone) 250/100 tabs, 1 BID may be reasonable substitute for atovoquone
  - Artemisia – herb used for malaria

Bartonellosis

— multiple Bartonella species

- Emerging diseases
  - Incubation:
    - Location: presumably in ranges of I. scapularis and I. pacificus
- Invades endothelial cells

Symptoms

- Fever, fatigue, headache, visual changes, disorientation, balance issues, ataxia, insomnia, joint pain, myalgia, numbness, cognitive deficits, poor memory, sore throat, sore soles

Findings

- Widespread, depending on infected tissues
  - Lymphadenopathy
  - Sina

Lab

- Serology for B. henselae
  - May pick up cross-reacting antibodies
- PCR
- Culture-enriched PCR

Treatment – optimal treatment unknown

- Doxycycline, azithromycin, rifampin, fluoroquinolones

Borrelia miyamotoi disease

— Borrelia miyamotoi

- Recently recognized pathogen
  - Relapsing fever species
  - Incubation:
    - Location: presumably over I. scapularis range
- Bacterium invades numerous tissues

Symptoms

- Fever, fatigue, headache, chills, myalgia, arthralgia, nausea
- EM-like rash in < 10%
No clinically available tests
- PCR tests under development; serology needs validation
- Culture methods unsuccessful

**Treatment**
- Doxycycline 100mg BID x 2 weeks
- No trial data

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**STARI**

- Pathogen unknown
  - *Not Borrelia lonestari*
  - Incubation: 7 days
  - Location: Within range of Lone star tick

- Symptoms
  - Similar to Lyme: EM-like rash, fever, headache
  - Stiff neck, myalgias, joint pain

- Lab
  - No available diagnostic tests

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**Tularemia**

- *Francisella tularensis*

- Multiple transmission routes
  - Tick and deer fly bites, contaminated water
  - Skin contact with infected animals, inhalation

- Tick transmission non-fatal
  - Location: South central, northwest, parts of Massachusetts

- Symptoms
  - Ulceroglandular form: skin ulcer at bite site, lymphadenopathy of regional nodes

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**Lab**

- Culture, immunohistochemical staining, PCR, direct fluorescent antibody, acute and convalescent titer

**Treatment**

- Same oral agents and duration as Lyme
  - No trial evidence
  - Rash phase – optimum duration unknown, 21 days common
  - Doxycycline 100 mg BID
  - Amoxicillin 500 mg TID

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**Lab**

- Culture, immunohistochemical staining, PCR, direct fluorescent antibody, acute and convalescent titer

**Treatment**

- Streptomycin or gentamycin for 10d
- Tetracyclines for 14d
- Ciprofloxacin
**Prevention**

Avoid tick-bites
- Be aware of tick habitats; avoid when possible
  - Live, work, play
- Make smart clothing choices
  - Limit skin exposure
  - Post-exposure: 60 min in dryer, high heat
- Pretreat clothing and gear with permethrin
  - Highly effective for 2-6 weeks; safe
- Use repellents on exposed skin
  - Picaridin, DEET, BoUD
  - Higher concentrations than for mosquitoes

**Tick checks post exposure**
- Find ticks before disease transmission
- Transmission times vary by pathogen
  - Powassan <15 min, Anaplasma, babesia < 24 hours
  - Lyme >24 hours

**Antibiotic prophylaxis may be appropriate**
- Lyme and possibly anaplasma
  - Doxycycline 100 mg twice daily for 10 - 20 days
- Contra-indicated for RMSF

**Summary**
- Several tick species transmit disease
  - Most species transmit multiple pathogens
- Wide range of disease severity
  - Mild to life-threatening
  - Disease incidence correlates with vector ranges
- Most diagnoses made on clinical grounds
  - Prompt diagnosis is critical; clinicians need high index of suspicion
  - Additional lab methods needed
- Antibiotic regimens vary; doxycycline treats most
  - Lyme, RMSF, spotted fever, ehrlichiosis, anaplasmosis, B. miyamotii disease, STARI, tularemia, bartonella

**Preventive measures should be encouraged**
- Relatively simple yet effective
- Tick bite avoidance strategies work across all tick species

*An ounce of permethrin is worth a pound of antibiotics*

Thank you