A Bug’s Life!
(aka, “Stuff Dr. Hunt Did Not Want to Talk About”)

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Potential Conflicts

• Had a wilderness medicine and travel show on Outdoor Channel and BoysLife.org

Turns out...

• Not a lot of $ in bug bites
• No longer conflicts of interest!
Another Disclaimer: You’re Gonna Itch!

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CLINICAL AND LABORATORY INVESTIGATIONS

Can itch-related visual stimuli alone provoke a scratch response in healthy individuals?

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Why is the Summer Different?
Consider “Outside Jobs”
Consider Temperature Extremes
Consider Anatomical Exposure
Consider Travel History

There are actually ZEBRAS in Africa!
Consider EtOH

David Senk; 54 yo in Sacramento:
“I get drunk, I get crazy. I don’t know. I’ve been an alcoholic for a long time.”
CASE #1:

New player in town... 8 yo boy comes home covered with these strange ticks that were not on anyone’s derm boards...

The clue is the number of these ticks in one place.
Asian Longhorned Ticks

- Not normally found in Western Hemisphere
- **First seen in U.S. in 2017**
- Found in Arkansas, Connecticut, Kentucky, Maryland, North Carolina, New Jersey, New York, Pennsylvania, Tennessee, Virginia, and West Virginia
- Found on pets, livestock, wildlife, people
- Female tick can lay eggs and reproduce WITHOUT mating
- **Thousands of ticks may be found**
- In other countries, bites can make people and animals seriously ill
- As of June 24, 2019, no infectious agent has been found in U.S.-collected ticks
CASE #2:
52 yo woman presents with a POSITIVE Review of Systems that includes heart palpitations, dizziness (2 episodes of recent syncope), dysphagia, and weight loss.

What was her Chief Complaint...

30 years ago?
Triatomine Bugs
a.k.a., Kissing bug, assassin bug, vampire bug, cone-nosed bug, barber bug, winchuka, benchuca
**Triatomine Bugs**

- Undergoes incomplete metamorphosis
  - Wingless instar nymph (2mm)
  - 5th instar nymph has 2 pairs of wings

- Produce a pungent odor when disturbed (isobutyric acid)

- Can also produce a sound by stridulation

- Feed on (mostly) vertebrate blood; **poop after biting!**

- Usually co-shelters with its host (rodents, armadillos, bats, birds, opossums)

- Feed at night when host is asleep and air is cooler
  - Odors (CO2 and ammonia) and heat guide the insect to its host; tend to “kiss” well-vascularized face or lips
  - Appear to be attracted to light

- ~5% of species are “domesticated”
  - *Triatoma infestans*
  - *Rhodnius prolixus*
At night I experienced an attack (for it deserves no less a name) of the *Benchuca* (a species of Reduvius) the great black bug of the Pampas. It is most disgusting to feel soft wingless insects, about an inch long, crawling over one's body.

Before sucking they are quite thin, but afterwards they become round and bloated with blood, and in this state are easily crushed. They are also found in the northern parts of Chile and in Peru. **One which I caught at Iquique, was very empty. When placed on the table, and though surrounded by people, if a finger was presented, the bold insect would immediately draw its sucker, make a charge, and if allowed, draw blood. No pain was caused by the wound. It was curious to watch its body during the act of sucking, as it changed in less than ten minutes, from being as flat as a wafer to a globular form. This one feast, for which the *benchuca* was indebted to one of the officers, kept it fat during four whole months; but, after the first fortnight, the insect was quite ready to have another suck.**

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*The Voyage of the Beagle* (journal entry March 26, 1835)
Why Should We Care?
Dr. Chagas Makes a Connection

• Dr. Carlos Chagas* (1909) discovered that intestines of Triatomines harbored flagellate protozoan (*Trypanosoma cruzi*); demonstrated transmission to marmoset monkeys after being bitten by an infected bug

• Parasite affects humans and wild mammals (birds are immune)

• Penetration of infected feces may further be facilitated by host’s scratching of bite area

He also discovered *Pneumocystis*!
Acute Chagas Disease

- Usually goes unnoticed; blood microscopy most useful in this stage
- May have localized swelling at bite site
- Effectively treated with...
  - Benznidazole (1\textsuperscript{st} line); FDA-approved in kids 2-12 years of age
    - Less than 12 years: 5-8mg/kg per day orally in 2 divided doses for 60 days
    - 12 or older: 5-7mg/kg per day orally in 2 divided doses for 60 days
    - SEs: Allergic dermatitis; Peripheral neuropathy; Anorexia and weight loss; Insomnia
  - Nifurtimox; available through investigational protocol from CDC
    - 10 or less: 15-20mg/kg per day orally in 3 or 4 divided doses for 90 days
    - 11-16 years: 12.5-15mg/kg per day orally in 3 or 4 divided doses for 90 days
    - 17 or older: 8-10 mg/kg per day orally in 3 or 4 divided doses for 90 days
    - SEs: Anorexia and weight loss; Polyneuropathy; Nausea/emesis; Headache; Dizziness/vertigo

Contraindications for treatment include severe hepatic and/or renal disease.
CDC also recommends withholding treatment while breastfeeding.

Questions regarding treatment? Parasitic Diseases Public Inquiries at CDC: 404-718-4745; e-mail chagas@cdc.gov
Circulating parasite levels fall quickly; undetectable by most methods.

Diagnosis by serologic testing for antibodies to the parasite.

CDC recommends 2 or more tests using different techniques:
- Enzyme-linked immunosorbent assay (ELISA)
- Immunofluorescent antibody test (IFA)

20-30% of patients develop symptoms 20-40 years after infection.

Heart: Inflammation → fibrosis → arrhythmias/stasis → syncope/stroke

Heart: Inflammation → fibrosis → CHF → dyspnea and peripheral edema

GI Symptoms: Megaesophagus/Megacolon → dysphagia, odynophagia, weight loss, prolonged constipation

One Theory: Darwin’s mysterious symptoms were from Chagas!
Chagas Epidemiology & Risk Factors

- Infection can occur from...
  - Contact with feces of infected triatomine bug
  - Mother-to-baby (congenital); estimated 40,000 woman of childbearing age are infected in U.S.; risk of transmission is 1-5%!
  - Contaminated blood products (transfusions)→screening in place (2006)
  - Organ transplanted from an infected donor
  - Laboratory accident
  - Contaminated food or drink (very rare)
- Endemic throughout Mexico and Central/South America (~11 million people are infected)
- Most people in U.S. acquire their infections in endemic countries...
NEGLECTED PARASITIC INFECTION:

Chagas Disease

More than 300,000 people in the United States are infected with Trypanosoma cruzi, the parasite that causes Chagas disease—and most don’t know it.

Learn more: www.cdc.gov/parasites/npi/
Where are they found in the U.S.?
- Can live indoors (under mattresses/bed stands)
- Beneath porches
- Rock, wood, brush piles, beneath bark
- In rodent nests or animal burrows
- In outdoor dog houses or kennels
- In chicken coops or houses

How do I know if they are in my domicile?
- Look for feces on walls; white (uric acid) or black (heme) streaks
- Whitish or pinkish eggs can be seen in wall crevices
- Pretty slow after a meal so you can sometimes just see them hanging out

How do I keep them out of my home?
- Seal cracks and gaps around windows, walls, roofs
- Remove brush piles
- Use screens on doors and windows
- Have pets sleep indoors at night
- Synthetic pyrethroid sprays are effective
- Roach hotels and other “bait” formulations do NOT work
The Moral of this Triatomine Story...

“Don’t Poop Where You Eat.”
CASE #3

Patient from Maine with known tick bite from this guy; had 4 weeks of Doxycycline; now presents with confusion, loss of coordination, difficulty speaking, and seizures.

a) RMSF
b) Babesiosis
c) Ehrlichiosis
d) 2nd stage Lyme
e) Something else
Powassan Virus: “Viral Lyme”

- Nationally notifiable condition
- Most prevalent in northeastern states and Great Lakes
- Primarily in late spring, early summer, and mid-fall
- Spread by 3 types of ticks:
  - *Ixodes* cookie (groundhog tick)
  - *Ixodes* marxi (squirrel tick)
  - *Ixodes* scapularis (blacklegged or deer tick)
- People do not develop high enough levels of virus in blood to infect biting ticks; we are thought to be “dead end” hosts

Blame this guy: White-footed mouse.
Powassan Virus: “Viral Lyme”

- Diagnosis should be considered in anyone with febrile or acute neurologic illness with tick exposure
- Incubation: 1-4 weeks
- Initial Sxs: Fever, HA, N/V, weakness
- Progression to encephalitis, meningoencephalitis, or aseptic meningitis
- Initial testing = ELISA; confirmed by neutralizing antibody testing
- CSF reveals lymphocytic pleocytosis; nl/mildly elevated protein; nl glucose; virus-specific IgM
- EEG shows generalized slow wave activity (resembles HSV encephalitis)
- MRI may show hyperintensities in superficial and deep white matter
- Reverse transcription-polymerase chain reaction can be performed on serum, CSF, and tissue (done at CDC)
- IHC can detect antigen in formalin-fixed tissue
CASE #4

72 yo female develops hives about 4 hours after eating a delicious steak → dizziness and nausea → difficulty breathing

What is this and which famous mystery author was she having dinner with?
Alpha-gal Allergy ("Red Meat Allergy")

- Galactose-α-1,3-galactose is a sugar molecule found in most mammals (except people, apes, and monkeys)
- Not found in fish, reptiles or birds
- Can be found in products made from mammals (medications, cosmetics, vaccines, gelatin, milk, etc.)
- Unclear how and why some people develop allergy to alpha-gal sugar molecule
- True allergic reaction about 3-6 hours after eating red meat or exposure
- Symptoms may occur after every exposure
- Most cases in southeastern and midwestern US
- Children and adults; most cases >50 years of age
- IgE antibodies are diagnostic
- Some of the original work that led to the discovery of this mystery was on John Grisham’s own Virginia property, with UVA
CASE #5
ERUPTIVE
“Breakfast, Lunch and Dinner”...

“All You Can Eat Buffet” sign
Krakowski et al. J Peds 2013
Biting Midges
(Family: Ceratopogonidae)

• Other names:
  • Sand fly (not Leish)
  • No-see-ums
  • Punkies
  • Five-Os
  • Pinyon gnats
  • Moose flies

• Originally thought not to transmit disease to humans→

CDC 2017: Detection of Elizabethkingia spp. in Australia midges; gram negative bacilli can cause septicemia; mortality rate of ~ 25%!
Mosquitoes

- Vector more disease than any other blood-sucking organism
  - Transmit malaria to 300 to 500 million people/year (3 million deaths/year)
  - Mosquito-transmitted diseases alone will be responsible for the deaths of 1 out of every 17 people currently alive!
- Found all over the world except Antarctica
- Use skin attractants to hone in on blood-meals
  - Daytime: Host movement and dark-colored clothing
  - General: Carbon dioxide, skin moisture, warmth, lactic acid
- Risk factors: Standing water, floral fragrances, EtOH, male, adult, obese
EPA Registered Skin-Applied Repellents

“Evaluated and approved for human safety and effectiveness when applied according to instructions”...“Do NOT pose risks to vulnerable populations including children and pregnant women.” ***Recommended by CDC.

1. Diethyltoluamide (DEET)*** – 500+ products
2. IR3535*** (3-N-Butyl-N-acetylaminopropionic acid, ethyl ester) – ~45 products
3. Picaridin*** (KBR 3023) - ~40 products
4. Oil of lemon eucalyptus*** (p-Menthane-3,8-diol, OLE, PMD) – 10 products
5. Catnip oil (Nepeta cataria, catmint) – 4 products
6. Oil of citronella – 3 products
7. 2-undecanone (methyl nonyl ketone) – 1 product

https://www.epa.gov/insect-repellents/find-repellent-right-you
Other Insect Repellents

• Unregistered plant products
  • Deemed “minimum risk pesticides” (1996)
  • Cedar oil
  • Geranium oil
  • Peppermint oil
  • Soybean oil

• Deemed “ineffective” measures
  • Garlic ingestion
  • Vitamin B1
  • Sound-emitting devices
  • Clips
  • Wrist bands
FTC Charges Company, Owner with Deceptively Marketing Mosquito Repellent Wristbands

Complaint Also Charges Defendants with Violating Prior Commission Order

FOR RELEASE
February 20, 2015

TAGS: Retail | Merchandise & Clothing | Bureau of Consumer Protection | Southwest Region | Consumer Protection | Advertising and Marketing

The Federal Trade Commission has charged Lou Lentine and Viatek Consumer Products Group, Inc. (Viatek) with making deceptive, unsubstantiated claims for Mosquito Shield Bands. The complaint also alleges that the defendant and his company violated the provisions of a 2003 administrative order barring him from making deceptive claims about any product he markets.
A Closer Look at DEET

- $N,N$-diethyl-3-methylbenzamide; formerly $N,N$-diethyl-$m$-toluamide
- Most effective and widely-used broad-spectrum insect repellent
- Stays active for up to 5 years when stored in cool, dry place
- EPA: Effective for **both** mosquitoes and ticks
- CDC: Can be used on infants older than 2 months of age
- Higher concentrations = longer-lasting protection (start to plateau @ around 50%)
- Firm guidelines not yet available
  - Use lowest concentration for time needed!
    - 4.5% lasts 1.5 hours, 24% lasts 5 hours
    - Do not use less than 10% if out for more than 1-2 hours
  - CDC website now says to use “20% or greater”
  - 10-35% DEET provides adequate protection in most circumstances

Fadin and Day, 2002
https://www.cdc.gov/malaria/toolkit/DEET.pdf
**DEET: Why Worry?**

- May be absorbed through skin → appears to be eliminated (including metabolites) within 4 hours of application in adults
- Most common problem: Skin irritation
- Very rare reports of neuro-toxicity
  - <50 cases of significant toxicity in 40 yrs (3/4 w/ 100% resolution)
  - 18 cases of encephalopathy
    - 14 cases under 8 years of age (3 deaths; 11 with complete resolution)
    - EPA study concluded product “posed no significant risks” to kids or adults (2001)
- Animal studies in rats and mice showed DEET ≠ selective neurotoxin
- Estimated risk: < 1 per 1,000,000 users based on worldwide usage patterns
- Risk factors: Long-term, heavy, or frequent use; whole-body application; oral ingestion

- **How about use with sunscreen?**
  - Concurrent/sequential application may reduce SPF by one-third
  - Different recommended application frequencies and volumes
  - Apply sunscreen first, then repellent

- Can damage plastics, rayon, and other synthetics!
- **Flammable!**
Repellent Recommendations

- Need to buy specific repellents for mosquitoes, ticks or both
- Do not apply under clothing; use only on open areas of skin and to clothing (controversial!)
- Avoid applying directly to face; apply to hands, then rub onto face
- Wash hands after application to avoid contact with eyes
- Wash-off with soap and water once indoors
- Do not use on open skin, cuts, wounds, or inflamed areas (e.g., eczematous skin!)
- Do not apply near food/water sources

CDC Recommendations: www.cdc.gov/travel/index.htm
Repellent & Kids

- Do not apply to infants under 2 months of age
- Oil of lemon eucalyptus not to be used in kids <3 yo
- Do not apply to hands of small children
- Do not allow young children to apply products themselves
- No evidence that 10% DEET is safer than 30%
  - Red Book, AAP, and CDC recommend not exceeding 30%
  - “Less may be more!”
  - Reapplication of low-strength repellent can compensate for inherent shorter duration of protection
LIFE LESSON: Tick-Proofing Your Yard

• Remove leaf litter
• Clear tall grasses at lawn edges
• 3-foot wide barrier of wood chips/gravel between lawn and woods
• Mow lawn frequently
• Stack wood neatly to discourage rodents
• Keep toys and playgrounds away from yard edges
• Fence when possible

Ticks suck.
Be careful out there!

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