Stinging Insect Allergy
What’s The Buzz?

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• I do not intend to discuss an unapproved / investigative use of a commercial product / device in my presentation.

Learning Objectives

After completion of this activity, participants will be able to:

• List the insects most commonly associated with allergic reactions, and their basic characteristics

• Describe the different types of insect sting reactions, and their acute treatment

• Describe the chronic management of insect sting reactions, including avoidance and venom immunotherapy
**ARTHROPODA phylum**

**CRUSTACEA** (crabs, lobsters, shrimp)

**ARACHNIDA** (spiders, scorpions, scabies, dust mites)

**INSECTA class**

**Several Others**

**HYMENOPTERA order**

**Vespidae family**

**Polistinae**

**Vespa** (true hornets)

**Dolichovespula** (hornet, aerial YJ)

**Vespula** (yellow jackets)

**Polistes** (wasps)

**Apidae family**

**Formicidae family**

**Myrmicinae**

**Pogonomyrex** (harvester ant)

**Solenopsis** (fire ant)

**Apis** (honey bee)

**Bombus** (bumble bee)

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**Indirect Effect of Arthropods**

- Transmission of infectious agents
  - ~700 million mosquito-transmitted diseases per year
  - ~3 million deaths per year
  - ~1 child dies of malaria every 30 seconds
- Damage to crops, animals, stored food
- Damage to ornamental trees, homes, etc.

- Grain weevils ruin from $6 billion to $12 billion of stored U.S. grain each year (5-10% of corn, soybeans, wheat, rice, sorghum, barley and other grains in US granaries)

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**Direct Effect of Arthropods**

- Immune mediated hypersensitivity reactions
  - Via: injection, contact, inhalation, ingestion
- Non-immune mediated reactions
  - Envenomation
  - Contact irritant dermatitis/urticaria, blistering, toxic
- Myiasis (direct tissue invasion by fly larvae)
- Psychiatric
  - Entomophobia, Delusions of Parasitosis, Illusions of Parasitosis

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Direct Effect of Arthropods

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Insect Allergy From Inhalation

Dust mites
- Dermatophagoides farinae
- Dermatophagoides pteronyssinus

Cockroaches
- Periplaneta americana
- Blatella germanica

Magnitude of Adverse Effects of Insects on Humans

- Transmission of disease
- Destruction of crops, non-food plants, food and homes
- Toxic envenomation

EPIDEMIOLOGY

- Life-threatening systemic reactions
  - ~0.4% - 0.8% of children, ~3% of adults
- Approximately 50-100 deaths/year in U.S.
  - Most quickly - with shock in 10-15 minutes
  - ~1% of fatal reactions have no previous history of reactions
  - Concomitant asthma is risk factor for death
- Sensitization is common - but not all are reactive
  - 2%-7% of "normal" people have venom-specific IgE
  - 12%-15% of population have positive venom skin tests
  - 20% positive for IgE if stung within last year
- Males > females (2:1)
- Direct correlation to time spent outdoors
Diagnosis of Insect Venom Allergy

• Clinical History
• Physical Exam
• Allergy Testing
  – Skin testing
  – Blood tests (IgE, Basophil activation)
• Sting Challenge

Examination of sting:
• May help distinguish between hymenoptera stings and other insects
• Will not differentiate type of hymenoptera
  – Fire ant stings have unique appearance

Insect Sting - History

• Activity of person at time of sting
  – Gardening, digging, hiking, lawn mower, etc.
• Location of person at time of sting
  – Under eave, near garbage, near pool, food, etc.
• Type of insect activity in area where stung
• Time of year, part of country
• Visual identification of insect
  – Bring dead insect, stinger
• Identification of insect by characteristics
<table>
<thead>
<tr>
<th>Apidae</th>
<th>Vespidae</th>
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<tbody>
<tr>
<td>Honey Bee</td>
<td>Bumble Bee</td>
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<tr>
<td>Nest</td>
<td>Yellow Jacket</td>
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<tr>
<td>Feed</td>
<td>Aerial YJ and W/B</td>
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<tr>
<td>Aggressive</td>
<td>Hornet</td>
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<tr>
<td>Leave Stinger</td>
<td>Paper Wasp</td>
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<td>Colonies</td>
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<tr>
<td>Nest</td>
<td>Low structures</td>
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<tr>
<td>Feed</td>
<td>Nectar Polen</td>
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<tr>
<td>Aggressive</td>
<td>European vs African</td>
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<tr>
<td>Leave Stinger</td>
<td>Yes</td>
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<tbody>
<tr>
<td></td>
<td>Commerically managed</td>
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<tr>
<td></td>
<td>Alarm pheromones</td>
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<td>Usually perennial</td>
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</tbody>
</table>

20 mm Dark to black colored
Fuzzy thorax
Bombus citrinus
"Bunch of grapes"
bumble bee nest
### Honey Bee
- **Colonies**: 100s-1000s
- **Nest**: Ground, low structures
- **Feed**: Nectar, Pollen
- **Aggressive**: Yes
- **Leave Stinger**: Usually
- **Other**: Commercially managed colonies, perennial

### Bumble Bee
- **Colonies**: 15-250
- **Nest**: Ground, low structures
- **Feed**: Nectar, Pollen
- **Aggressive**: Yes
- **Leave Stinger**: Usually
- **Other**: Perennial, slow annual

### Yellow Jacket
- **Colonies**: 50-5000
- **Nest**: Aerial
- **Feed**: Predacious, scavenger (meat, sweet)
- **Aggressive**: +++
- **Leave Stinger**: No
- **Other**: Light annual, small hairs on thorax, not fuzzy

### African Hornet
- **Colonies**: 1500-2000
- **Nest**: Paper nest on outside wall of house
- **Feed**: Predacious, scavenger (meat, sweet)
- **Aggressive**: ***
- **Leave Stinger**: No
- **Other**: Annual, late summer

### Wasp
- **Colonies**: 25-300
- **Nest**: Ground, aerial
- **Feed**: Predacious, scavenger (meat, sweet)
- **Aggressive**: ***
- **Leave Stinger**: No
- **Other**: Annual, late summer

### European Hornet
- **Colonies**: 1500-2000
- **Nest**: Ground, aerial
- **Feed**: Predacious, scavenger (meat, sweet)
- **Aggressive**: ***
- **Leave Stinger**: No
- **Other**: Annual, late summer

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**Imported Fire Ants**

- Native to Argentina, Uruguay & Brazil
  - U.S. – 1918 in Mobile, AL
- 30-60% of population in infested urban areas are stung each year, anaphylaxis in 0.6 - 1% of stings
- Common around human areas, roadways
  - Attracted to electricity/ozone
  - Very aggressive, attack in mass, repeated stings
    - Crawl 1.6 cm/sec (crawl from foot to waist on an average adult in 60 seconds)

*Texas Imported Fire Ant Research and Management Project*  
*http://fireant.tamu.edu/img/ants/img11334_med.jpg (Photo by Bart Drees)*

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Which one is the ‘Killer’ Bee?

- Entered U.S. 10/90 at Hidalgo, TX
- First U.S. fatality 7/93 in Harlingen, TX
- Less venom/sting, but similar composition
- More aggressive when disturbed
  - Defend with hundreds versus dozens of bees
  - ++ More ‘alarm’ pheromone released with stings
  - "Time to anger" 3 seconds vs. 19 seconds
  - "Defend/chase" 1/2 mile vs. 450 yards
- Less selectivity of hive sites--more likely to be near human activity

Mass Stinging
Africanized Honey Bees
• LD$_{50}$ approximately 19 stings/kg
  – 1100/1400 stings for average female/male
• May be much less in those with underlying cardiovascular, respiratory or neurologic disease
• 500 stings approximates 1 rattlesnake bite

Quantity of Venom
• Honey bee -- ~30-50 mcg/sting
• Bumble bee -- ~10-30 mcg/sting
• Wasp -- ~5-17 mcg/sting
• Hornet -- ~2.5-5 mcg/sting
• Yellow jacket -- ~1.7-3.1 mcg/sting
• Fire ant -- ~0.05-0.1 mcg/sting

Types of Insect Sting Reactions
• Local (“Expected” or “Normal”)
  – Unique local for fire ants
• Large local
• Systemic
  – Cutaneous
  – Multi-systemic (life threatening)
• Toxic (envenomation from mass stingings)
• Idiopathic
  – Serum sickness, Guillan-Barre, nephritis, vasculitis, others

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Local Reactions

• “Normal” or “expected” reaction to venom components of stings
• Pain, itching, erythema, edema at site of sting
• Usually transient (hours) may last a few days
• Fire ants have unique “normal” local reactions


Fire Ant Bite - Sting

Reschly MJ. Cuts 2006:66:173 (Photo by Murray S. Blum, University of Georgia Creative Commons Attribution 3.0 License.)

Multiple Fire Ant Stings
Fire Ant Sting
72 hours

http://www.entomology.msstate.edu/resources/tips/ants/stingdescriptions.html

Fire Ant Sting
1 week

http://www.entomology.msstate.edu/resources/tips/ants/stingdescriptions.html

Fire Ant Sting
1 month

http://www.entomology.msstate.edu/resources/tips/ants/stingdescriptions.html
Acute Management
Local Reactions

• Prompt/proper removal of stinger
  – “Scrape out” (speed more important than technique)

• Keep area clean
  – Prophylactic antibiotics not recommended
  – Tetanus prophylaxis usually not indicated
  – Consider for ground dwelling vesps

• Symptomatic treatment as needed
  – Antihistamines for itching, cool compresses
  – Pain medicine (acetaminophen)

• For fire ants - do not unroof vesicle, allow to dry

Large Local Reactions

• >10 cm in size
  – Often crosses over a joint

• Contiguous with site of sting

• Peaks at 48-72 hrs & can last days to wks

• Pain, itching, erythema, warmth, swelling, numbness
  – Compartment syndrome possible if severe

• ~95% of patients with LLR will have +IgE

Large Local Reactions

• Remove all possible ‘constrictors’ (rings, watches, bracelets, piercings, etc.)

• Cool compress, elevation

• Pain medications & antihistamines

• Systemic steroids for significant swelling
  – Or start prophylactically for those with a past history of significant swelling

• Monitor for complications (secondary infection, compartment syndrome)
Secondary Infections

- Antibiotics not part of routine treatment of local or large local reactions
- Late onset (>2-3 days) ascending lymphangitis, regional lymphadenopathy and fever suggest infection
  - Of those infected: *Staph. aureus* in ~75%
  - *MRSA* as in community
- May be more common in vespid stings

Systemic Reactions

- **Cutaneous**
  - Urticaria, angioedema, generalized flushing / pruritus
- **Multi-system (anaphylaxis)**
  - **Laryngeal edema** (dyspnea, stridor, hoarseness, difficulty swallowing, lump in throat, drooling)
  - *Bronchospasm* (dyspnea, chest tightness, wheezing)
  - *Hypotension*, arrhythmias (dizziness, pale, fainting), bradycardia, angina, MI
  - Nausea, vomiting, diarrhea, uterine contraction

* = Life-threatening    ** = Most common cause of death

Acute Management
Systemic Reactions

- Treat like anaphylaxis from any trigger
- Cutaneous only: antihistamines, glucocorticoids
- Systemic
  - Epinephrine
  - Bronchodilators, steroids, antihistamines
  - Volume expanders, pressors, respiratory support (oxygen, airway maintenance, assisted ventilation)
- Biphasic / protracted reactions can occur
  - Observation at least 6 hours after resolution
  - Less common than with foods

Risk of Systemic Reactions Upon Re-sting

- Reactions usually stereotypical (not always!)
- Related to severity of initial reaction and age and interval between stings
  - Short interval between stings increases the risk for reaction to subsequent stings
  - Risk of systemic reactions remains 20-30% even after 10-20 years
  - Numerous and frequent stings (>200/year) may induce tolerance

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Venom Allergy Testing

- Skin test is preferred over blood IgE tests
- Any individual with systemic reaction
  - Selected patients with large local reactions
- If venom skin test is negative but patient has a convincing history and/or severe reaction:
  - Use venom-specific IgE (“RAST”) to confirm
  - If blood IgE testing is also negative, repeat skin and blood tests in 3-6 months


Goals of Venom Immunotherapy (“Allergy Shots”)

- Prevent systemic reactions in high-risk patients
- Alleviate patient anxiety relative to insect stings


VIT - Indications

- Demonstrate presence of venom-specific IgE
- Systemic reaction in any age (absolute)
- Cutaneous reactions in adults (>16 years)
  - Children with cutaneous reactions only typically have more benign course
- Large local reactions (LLR) in adults to prevent anaphylaxis and ↓ severity of LLR
- LLR in children to ↓ severity of LLR
- Other considerations
  - Risk of re-sting, life-style changes (QOL), accessibility to medical care, coexisting medical and psychosocial conditions

Valentine MD. NEJM 1990;323:1601; Golden DBK. J Allergy Clin Immunol 2011;127: (854e1)
VIT - Efficacy and Safety

- >95% effective in preventing systemic reactions upon re-sting
  - ~80-90% for honey bee
  - Some evidence that VIT may decrease severity of large local reactions and serum sickness
- Up to 12% have adverse reaction to VIT
  - Overestimate? - especially in children
- Rare reports of fatal reactions after completion of course VIT + negative skin tests

Golden DBK. NEJM 2004;351:668; Golden DBK. J Allergy Clin Immunol 2011;127: (854e1)

VIT - Duration of Treatment

- Recommended duration -(3-) 5 years
  - 5 years is optimal (less relapse than 3 years)
- Possibly longer or indefinite(?) if:
  - Severe initial reaction
  - Systemic reactions from VIT or from ‘field’ sting
  - Honey bee VIT
- Considerations:
  - Effect on QOL (work/leisure), comorbidities (disease/meds), risk of exposures (work/leisure), psychosocial factors, patient preference


Auto-injectable Epinephrine

- Mandatory for all patients with prior systemic reactions (including cutaneous)
  - Should prescribe at least 2 per patient
- ? For those with large local reactions
- Not necessary for local reactions
- No absolute contraindication
- EpiPen®, Auvi-Q™, generic
  - ~1/3 of patients presenting to ED receive Rx for epinephrine
  - Only 20-39% referred to allergist

**Referral To An Allergist**

- Systemic or anaphylactic reactions to known or suspected insect sting
- Cutaneous or large local reactions in most pts.
- Need education regarding stinging insect avoidance and emergency treatment
- Might be a candidate for venom immunotherapy
- Has co-existing situation that might complicate treatment of anaphylaxis (e.g. beta-blocker therapy, asthma, cardiac problems, etc.)
- Patient anxiety

Golden DBK. *J Allergy Clin Immunol* 2011;127: (854e1)

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**Insect Avoidance**

Use Caution in High Risk Situations

- At home- garbage areas, eaves, wall cavities, tree hollows, pool
- Keep them outside (fix cracks, holes, screens, inspect periodically)
- With gardening, digging, tree trimming, taking out garbage, swimming, hiking
  - Esp. vibration: mowers, hedge trimmers
- In the wild- decaying logs, stumps, trees, subterranean cavities

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*The Far Side* 8/25/88
Gary Larson

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Insect repellents (e.g. DEET, etc.) do not work for stinging insects!

“We’ll use a minute... McCallister, you feel! That isn’t what I said to bring.”

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Insect Avoidance
Personal Protection

• Avoid insect ‘attractants’
  – Don’t act like a flower! (no bright colors, dark colors, perfumes (cosmetics, sunscreens, etc.))
  – Sweets, meats, rotting fruit, outdoor pet food
  – Body odor, perspiration, suede, leather, wool

• Wear ‘insect-resistant’ clothing
  – Light/white cotton, smooth-finish texture
  – Cover as much of body as possible
  – Elastic wrist/ankles, ankle-high shoes, long white socks, tuck in pant legs into socks

Insect Avoidance
Common Sense Measures

• Leave high-risk area if possible
  – Insect pheromones

• Call professionals to eradicate any known or suspected nests
  – Consider periodic surveillance by experts

• Don’t tease, swat, ‘rescue’, etc., avoid rapid movements (esp. near hive/nest)

• Keep insecticides handy (esp. for car)

• Never walk outside without shoes

“Bee-zoar”

“…she had been thirsty and described having taken a long, deep swallow from a soft-drink can. She felt a sudden pain in her oropharynx…”

Endoscopic View of the Bee in Patient’s Stomach