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July 2007 "Insect Bites & Stings" 707-000-07-007-H01

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THIS MONTH--  
"Insect Bites & Stings"

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**HAVE YOU RECENTLY MOVED? PLEASE NOTIFY US.**

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It's summer, and patients ask a lot of questions about insect bites & stings. This is the rationale for selection of this month's topic. This lesson provides 1.25 hours (0.125 CEUs) of credit, and is intended for pharmacists in all practice settings.

**The program ID # for this lesson is 707-000-07-007-H01.**

**Pharmacists completing this lesson by July 31, 2010 may receive full credit.**

**To obtain continuing education credit for this lesson**, you must answer the questions on the quiz (70% correct required), and return the quiz. Should you score less than 70%, you will be asked to repeat the quiz. Computerized records are maintained for each participant.

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**The objectives of this lesson are such that upon completion the participant will be able to:**

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1. Differentiate between signs & symptoms of stinging & biting insects.
  2. List insects that belong to Hymenoptera, and components of their venom.
  3. Describe pathophysiology of insect bites & stings.
  4. Discuss medications used for symptomatic relief of insect bites.
  5. Describe use of insect repellants.
  6. List side effects of nonprescription medications for treating insect bites.
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## INSECT STINGS

Insect bites and stings cause at least 100 deaths annually. At least 100,000 cases require medical attention. Most, if not all, deaths occur as a result of anaphylactic reactions. It has been estimated that about 0.3 to 3% of the population in the U.S. show signs of anaphylaxis following an insect sting. Such reactions may range from swelling and irritation to bronchospasm and death resulting from circulatory collapse. Insect stings are most common during the summer months and early fall. Individuals who spend time outdoors, especially if they are wearing perfume, are at highest risk.

The stinging insects belong to the order **Hymenoptera** of the class insects. The families within Hymenoptera that we are most familiar are apids (Apidae—bumble bees & honey bees), vespids (Vespidae—wasps, yellow jackets and hornets) and formicids (Formicidae—fire ants). These insects possess venom that is responsible for anaphylactic reactions in sensitive patients. The venom contains a number of allergenic proteins and several pharmacologically active compounds. The venom varies from one subgroup to another, but as a whole, it is capable of triggering anaphylaxis. Wild honeybees are encountered in the Western and Midwestern parts of the U.S., and are usually found in hollow tree trunks. Wasps, hornets and yellow jackets are common in the South, Central and Southwestern U.S. Paper wasps live mostly under eaves of houses or in high places such as trees. Hornets are found in hollow spaces, whereas yellow jackets nest in the ground, cracks around houses or in small shrubs. Apids usually are not aggressive, and attack only when they are disturbed. Africanized honeybees (killer bees) originated from South America and now are found in some Southern U.S. states. They are known for their aggressiveness when provoked and usually attack in swarms. Vespids attack mostly when agitated. Humans are stung more often by vespids than apids due to the fact that they nest close to homes. Therefore, provocation occurs frequently. Yellow jackets cause more stings and allergic reactions than other members of Hymenoptera.

The quantity of venom provided by these insects is tiny in comparison to snakes, but maybe as potent. When death occurs following a sting, it is generally caused by allergic hypersensitivity. The anaphylactic reaction in a sensitive individual may occur within five to thirty minutes following the sting. It has been estimated that 500 or more stings to a non-sensitive person may result in death due to toxicity rather than hypersensitivity. Stinging insects introduce the venom into their victims via a stinger that pierces the skin. The stinger, a modified ovipositor, is attached to the rear of the female abdomen. Since males have no ovipositor, they are stingless. The stinger has a poison canal that is attached to the venom sac. The stinger is directed posteriorly. Apid stingers have barbs that remain firmly embedded in the skin. After it jabs the stinger, apids try to fly away. However, the firmly embedded barbed stinger along with the venom sac remain in the flesh. The insect later dies. The stinger that is left behind is driven deeper into the skin by rhythmic contractions of the venom sac's smooth muscles, and continues to release venom into the victim. Vespid stingers differ from those of apids in that they do not have barbs. As a result, such insects can withdraw the stinger and inflict multiple stings. After injection of the venom, the stinger can be withdrawn, enabling the insect to survive and attack again. Fire ants, in particular the species *Lenopsis invicta*, are found in the southern parts of the U.S. It has been estimated that 40% of the population may have been exposed to fire ant stings. These are capable of producing pain and irritation as well as allergic reactions. Some ants only bite, whereas others can bite and sting simultaneously. Stinging fire ants, of the species *L. invicta*, use their mandibles to cling to the skin of the prey. Then they bend their abdomen, sting the flesh and empty the contents of their poison vesicles into the wound.

## COMPOSITION OF VENOM

Venom of apids and vespids contain phospholipase A, hyaluronidase, a protein known as antigen 5 (mostly allergenic), histamine, meletin, apamin, and a mast-cell degranulating peptide. Fire ant venom consists

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of hemolytic, cytolytic and 3 or 4 aqueous protein fractions that trigger the allergic reaction following a sting.

### **SIGNS AND SYMPTOMS OF STINGS**

The reaction to insect stings can be local and/or systemic. The thrust of the stinger into the flesh followed by injection of venom is accompanied by some pain. The subsequent reactions depend on the victim's sensitivity. The local reaction is immediate and consists of burning, transient pain, itching, erythema, swelling and induration (hardening of the tissue). The swelling and induration usually subsides within 48 hours, but can persist for a week. Some systemic reactions may include urticaria, angioneurotic edema, bronchospasm and lowering of blood pressure. Swelling occurs in most cases, and is not an allergic sign. Nausea, vomiting, abdominal cramps and diarrhea are common. To develop sensitivity to insect stings, an individual had to be previously exposed to the venom. The first sting is considered the sensitizing one. The venom may trigger a mild reaction, but in severe cases may result in a rapid anaphylaxis leading to death. Following the initial sting, the antibody immunoglobulin E (IgE) is formed and binds to receptors on the mast cells and basophiles. Each subsequent sting will produce more antibodies that lead to stronger allergic reactions. Once the allergen (venom) enters circulation, it reaches the IgE on the mast cells and an allergen-antibody reaction takes place causing degranulation of the mast cells and the release of the chemical mediators such as histamines, prostaglandins and leukotriens. These chemicals are potent vasodilators and bronchoconstrictors. The vasodilation results in a drop in blood pressure, and an increase in the permeability of blood vessels leading to edema and swelling. The most commonly involved organs in the anaphylactic reactions are the skin, respiratory, cardiovascular and gastrointestinal systems. Most fire ant stings produce itching, pain and burning. A significant percentage of the population show systemic reactions to fire ant stings, and approximately 2% experience anaphylaxis. When it attacks its victim, the fire ant clings to the skin and its mouth bends its body while pivoting around the bite site and stinging repeatedly on the circumference of the resulting circle. An immediate wheal, pain and pruritus occur. Within 24 hours, a pustule at the site of the sting develops. It appears that there is very limited or no cross-sensitivity between the venom of the fire ant and that of other members of Hymenoptera. However, there is cross-sensitivity between apids and vespids.

### **TREATMENT**

As indicated earlier, the stinging members of Hymenoptera produce different outcomes. For example, the stinger of the honeybee has barbs which allow it to remain in the skin. Therefore, the stinger, which usually contains the venom sac, often must be removed with a tweezer to prevent the release of venom. Using the fingers is not recommended as this may squeeze more venom into the victim. Prompt application of ice packs to the sting site tends to reduce the rate of venom absorption as well as irritation, pain, itching and swelling. Preventative measures such as avoidance of wearing perfume, scented lotions, and bright colored clothes as well as control of odors in picnic and garbage areas are helpful. Destruction of nests of stinging insects around the house should be done with caution.

There do not seem to be any effective or FDA approved nonprescription medications for insect stings. The labels of insect products, however, deal with insect bites. The FDA allows the wording "for temporary relief of stings caused by wasps, hornets, bees, mosquitoes, spiders, fleas, chiggers, ticks and ants." For local reactions to insect stings, relief can be obtained by using external products that contain local anesthetics, menthol, calamine lotion and antihistamines.

The usual, initial drug of choice for treating anaphylaxis resulting from insect stings is epinephrine. Antihistamines may be administered concurrently. Antihistamine injections are not useful in emergency treatment due to slow onset. Epinephrine is an  $\alpha$ ,  $\beta$ , and  $\beta_2$ -antagonist. Activation of  $\alpha$  receptors that cause vasoconstriction in the internal organs, mucosal surface and skin, results in elevation of blood pressure. Because  $\beta$  receptors control the bronchial tree, activation of these receptors results in bronchodilation, thereby relieving chest tightness, dyspnea, and wheezing which some sensitive patients may experience following an insect sting. Sensitive patients are advised to carry an injectable form of epinephrine with them to use only when they are stung. Epinephrine is not used as maintenance therapy. A prescription drug such as Epi-Pen Auto-Injection<sup>®</sup>,

which contains a 0.3 mg subcutaneous dose of 1:1000 epinephrine in a 2 ml disposable prefilled injector, is easier and faster to use than epinephrine in ampules, which must be withdrawn and injected with a syringe.

Prophylactic treatment of insect stings may be attempted. Hymenoptera venom is used to treat hyperallergic patients. Venom immunotherapy may be achieved by subcutaneously injecting small amounts at regular intervals. The dose is gradually increased over time. Depending on the severity of the allergic reactions, the duration of the immunotherapy may be from a minimum of two years to several years.

### **INSECT BITES**

For the most part bites from insects such as mosquitoes, fleas, bedbugs, ticks, chiggers, mites and lice do not contain venom, but may contain substances that cause skin reactions such as itching, irritation and erythema. Such insects attack their victims by piercing the skin with their biting organs to feed by withdrawing blood from their hosts. The insects possess certain anticoagulant components in their saliva to prevent blood from clotting. This allows free flow from the wound to the insect.

### **MOSQUITOES**

Mosquitoes are found in all regions of the world, especially in humid, warm climates. They breed in wet areas where water is abundant. Mosquitoes hide during the day and become active in the afternoon and evening. When these insects alight on exposed parts of the body, they puncture the skin with their mandibles and maxilla. Mosquitoes possess a hollow flexible proboscis that is used to suck blood from the cut or from previously exposed blood vessels. As the mosquito feeds, it introduces an anticoagulant and antigenic compounds to keep blood flowing. Such chemicals can cause itching and wheals. These symptoms usually begin within 10 minutes following the bite and may last for 1 to 2 hours. Children may experience a delayed reaction to bites.

### **FLEAS**

Fleas are commonly encountered throughout the world especially in warm and humid areas. They are blood sucking insects that possess strongly developed posterior legs, that enable them to leap. They are capable of surviving and multiplying without food for several weeks, but a female requires blood meals to deposit eggs. Abandoned places may be heavily infested. Fleas attack humans, especially those living with infested pets. Flea bites are usually multiple and often affect the legs and ankles. The lesions are erythematous in nature and cause severe itching. The first bite inflicted by a flea does not cause any local reaction. However, the person will react following repeated bites. Each bite will cause a more intense reaction than the preceding one.

### **BEDBUGS**

Bedbugs are small insects about 5 mm long and 3 mm wide. They are flat and have a short head. They possess mouth parts with two pairs of stylets for piercing the skin. Usually they reside inside homes and hide during the day, but become active and attack their victims at night. Bedbugs deposit their eggs in crevices of walls, floors, bedding and other furniture. When a bedbug attacks its prey, it uses its mouth parts to pierce the skin and to suck blood. During the feeding process, salivary secretions from the insect enter the wound. A bedbug can become fully fed within 5 minutes. Reactions to bites may range from irritation at the bite site to moderate or severe erythema.

### **TICKS**

Ticks are biting insects that mainly effect wild and domesticated animals. Humans may also be victimized. A number of species transmit diseases such as Lyme disease and Rocky Mountain Spotted fever. Ticks have mouth parts that enable them to pierce the skin of their prey and to attach themselves to the wound. Because the mouth parts are embedded in the skin, sudden removal of the tick may result in tearing the mouth parts, which then remain within the skin. Intense itching and inflammation may follow. To prevent this from happening, a tick should be removed gently to keep its body intact. A fine tweezer or the fingers may be used.

Fingers should be protected by gloves and thoroughly cleansed after the extraction process. If the tick remains in place, it continues to feed until it is engorged with blood. Within ten days, the tick drops off.

### **CHIGGERS (REDBUGS)**

Chiggers are tiny insects that usually infest shrubbery, trees and grass. The hungry larvae are responsible for attacking the victim in order to feed. Microscopic larvae invade the skin by inserting their mouth parts into the flesh and releasing a fluid that causes cell disintegration as well as itching and red papules. Due to the effect of the digestive fluid, the skin hardens and a narrow tube is formed. This has led to the misconception that chiggers burrow in the skin. Once larvae enter the tube, they continue to feed until engorged, after which they leave and eventually become adults. Chigger bites cause intense itching and irritation. Exposed parts of the body such as the face, neck, forearms and legs are vulnerable to attack.

### **SARCOPTES SCABIEI (SCABIES)**

Scabies are a parasitic skin infection caused by a tiny mite called **sarcoptes scabiei**. The infection caused by these organisms is very contagious and can be transmitted from an infected individual to a healthy one by physical contact or by wearing infected clothes or using towels. The infection is characterized by the formation of burrows in the skin. Such burrows are formed by the impregnated females in order to deposit their eggs. The female uses her jaws and first two pairs of legs to form the tunnel that is usually about one centimeter long. Within a few days, the eggs hatch to release larvae that establish their own tunnels and remain there until they become adults. The adults might reproduce, and the impregnated females start a new cycle by burrowing in the stratum corneum of the skin. The infestation spreads rapidly from the site of the initial infection to the rest of the body. The most common sites of infections include interdigital spaces of the fingers, the flexor surface of the wrists, the external male genitalia, the buttocks and the anterior axillary fold.

### **TREATMENT OF INSECT BITES**

One of the complications of insect bites is the formation of secondary bacterial infection. This may happen as a result of scratching provoked by itching. Thus, the main objective of treatment is to provide symptomatic relief and to prevent secondary bacterial infections as well. Certain measures such as applying ice packs immediately following bites of mosquitoes, chiggers, fleas and bedbugs should provide temporary relief of itching. The application of nonprescription drugs containing local anesthetics are more effective than ice packs. In case of broken skin, a preparation containing an antibacterial should prevent secondary bacterial infections. Caution should be exercised when using nonprescription drugs for treating bites. The medication should be applied to the bite site only. Children 2 years of age and younger should not be exposed to these. Pediatricians must be consulted for treating children of this age.

The most common agents used in nonprescription drugs for symptomatic relief of insect bites include local anesthetics, counter irritants, topical antihistamines, hydrocortisone and protectants.

### **LOCAL ANESTHETICS**

Benzocaine is the most common local anesthetic. Others that may be used are pramoxine, benzyl alcohol, lidocaine, dibucaine and phenol. Except for phenol, these agents act by blocking conduction of nerve impulses at the site of application resulting in loss of feeling. Phenol on the other hand acts by suppressing cutaneous sensory receptors. Patients allergic to benzocaine should refrain from using it. Systemic absorption following the application of dibucaine may occur if applied in large quantities and over exposed skin or blistered areas. Convulsions, myocardial depression and even death have been speculated following such application. Phenol-containing preparations should not be applied over large areas of the body nor under compresses or bandages. Products containing anesthetics carry the following FDA approved label "for temporary relief of pain and itching due to minor burns, sun burns, minor cuts, abrasion, insect bites and minor skin irritation." Insect bite products are available as creams, ointments, aerosols or lotions. One of the main side effects of the topical use

of benzocaine is the risk of developing sensitization. Pramoxine and benzyl alcohol have less or no adverse effects. Dibucaine is capable of causing systemic toxicity as a result of absorption following extensive application.

### **COUNTER IRRITANTS**

Counter irritants, such as camphor and menthol, are compounds used in insect bite products to reduce pain and itching by stimulating sensory receptors, thereby giving the feeling of coolness. Camphor is toxic if taken internally. In concentrations of 1% or less, menthol acts as a cutaneous receptor depressant and as an external analgesic. It is a safe and effective antipruritic when used in such concentrations.

### **LOCAL ANTIHISTAMINES**

Topical diphenhydramine hydrochloride is used in many products for insect bites. When applied on the skin, antihistamines relieve itching and pain by depressing cutaneous receptors. A limited systemic absorption may occur. However, such small quantities have no significant adverse effects. Prolonged use may cause hypersensitivity reactions. These products should be limited to use for no more than one week unless the patient is advised by a physician.

### **HYDROCORTISONE**

Hydrocortisone is an anti-inflammatory drug that when applied in concentrations of 1% or higher will relieve the formation of edema, inflammation, swelling, itching, irritation and pain. The FDA has approved the use of topical hydrocortisone in concentrations of up to 1%. These are used for temporary relief of itching, dermatitis, insect bites, poison ivy/oak/summac, as well as skin reactions due to contact with soaps, cosmetics or jewelry.

### **SKIN PROTECTANTS**

Astringents such as zinc oxide, calamine, and titanium dioxide are used in the form of lotions ointments and creams for the relief of irritation and inflammation. Additionally, they possess mild antiseptic and antibacterial action. Zinc oxide and calamine are usually incorporated in various dosage forms in concentrations ranging from 1% to 25%. Titanium dioxide possesses action similar to that of zinc oxide; however, its effectiveness and safety have not been determined. Preparations containing protectants have minimal adverse effects and can be used by infants, children and adults.

### **PREVENTION OF STINGS OR BITES**

Avoiding insects by covering the skin with clothing; cuffing the clothing around the ankles, wrists and neck; avoiding standing water, thick woods, and shrubbery that acts as a nesting place for insects; and insuring that pets remain free of fleas and ticks are good measures for the prevention of insect bites. Insect repellents can be helpful. Acceptable repellents should have no odor, long duration of action (several hours), wide spectrum of activity against biting insects, be non-irritating to the skin, and withstand various weather conditions. DEET (Meta-N,N-diethyl toluamide) is a very common insect repellent. The exact mechanism of action is unknown, but it appears that its vapor is offensive to insects, thereby preventing them from attacking the sprayed area. DEET is available as: aerosols, solutions and creams. To provide adequate protection, repellents should be applied every 4 to 8 hours. Application on children 2 years and younger is not recommended. Incidents of encephalopathy and other CNS disorders have been reported following excessive use of DEET in young children. Adverse effects of insect repellents include burning, itching and irritation at the application site, especially if the skin is broken or if applied on a mucus membrane. Application around the eyes should be avoided. Other insect repellants that may be used are ethohexadiol, dimethyl phthalate or dimethyl ethyl hexanediol carbonate.

### **PEDICULOSIS (LICE INFESTATION)**

Lice are parasitic, biting insects that infest humans by living on the scalp or other parts of the body. It is very contagious. There are three types of lice that affect humans: head lice, body lice and pubic lice. Head lice

(pediculus capitis) is the most commonly encountered, and sometimes reaches epidemic proportions. Over 10 million cases are reported annually in the U.S. Most cases are encountered in children 1 to 12 years of age. The outbreaks occur mostly in crowded places such as schools, day care centers, nursing homes or armed forces barracks. The adult female deposits between 10 and 150 eggs (nits) which are glued to the hair. Within 5 to 10 days the eggs hatch and release nymphs (newly hatched lice) that begin the feeding process immediately. Body lice (Pediculus corporis) live and deposit their eggs in clothing, especially the seams and folds of underwear. They leave their hiding places when the victim is motionless, for example during sleep. Pubic lice (Phthirus pubis) are larger than head lice. They are also known as crab lice due to their appearance. They are transmitted by all types of contact.

The bites of lice cause intense itching, and a wheal may appear in patients who are exposed to bites for the first time. Scratching provoked by itching may result in pyogenic infection. Nonprescription drugs are available and are effective in treating lice infestations. Such medications may contain **pyrethrins** and **permethrin**. **Pyrethrins** are extracted from chrysanthemum flowers. **Pyrethrin** acts by blocking nerve impulse transmission and causes paralysis and subsequent death of the insect. The drug is used in concentrations ranging from 0.17% to 0.33% along with 2% to 4% of piperonyl butoxide. The drug has a low index of toxicity when used as directed. **Permethrin** is a synthetic pyrethroid and is effective in treating lice. With prolonged and repeated use, resistance may develop. It acts by disrupting sodium channels, delaying repolarization and resulting in insect paralysis. The main side effects are: transient itching, burning and irritation.

### SUMMARY

Insect stings and bites are common occurrences. Stings that contain venom may cause anaphylactic reactions in sensitive individuals. Insect bites may cause local reactions such as itching, burning, irritation and swelling. Such bites may be treated by using nonprescription drugs; however, these medications are not effective in combating insect stings.

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**LESSON EVALUATION**

Please fill out this section as a means of evaluating this lesson. The information will aid us in improving future efforts. Either circle the appropriate evaluation answer, or rate the item from 1 to 7 (1 is the lowest rating; 7 is the highest).

1. Does the program meet the learning objectives?

- |  |     |    |
|--|-----|----|
| Differentiate between signs & symptoms of stinging & biting insects  | Yes | No |
| List insects that belong to Hymenoptera, & components of their venom | Yes | No |
| Describe pathophysiology of insect bites & stings                    | Yes | No |
| Discuss medications used for relief of insect bites                  | Yes | No |
| Describe use of insect repellents                                    | Yes | No |
| List side effects of nonprescription medications for insect bites    | Yes | No |

2. Was the program independent & non-commercial Yes No

	Poor		Average		Excellent		
3. Relevance of topic	1	2	3	4	5	6	7

4. What did you like most about this lesson? \_\_\_\_\_

5. What did you like least about this lesson? \_\_\_\_\_

**Please Select the Most Correct Answer**

1. Hornets belong to which of these?

- A. Vespids
- B. Apids
- C. Formicids
- D. Optera

2. Which statement is incorrect?

- A. Apid stingers have barbs
- B. Honeybees die after stinging
- C. Male honeybees are stingless
- D. Honeybees die after stinging due to toxicity

3. What is not a component of insect venom?

- A. Meletin
- B. Lipase
- C. Phospholipase-A
- D. Apamin

4. Which measure is recommended after insect stings?

- A. Remove stinger with fingers
- B. Promptly apply ice packs
- C. Immediately inject antihistamines
- D. Use a tweezer

5. Which statement is true about fleas?

- A. Are not blood sucking insects
- B. Bites are usually singular
- C. Capable of surviving without food for several weeks
- D. Bites cause little or no reactions

6. Chiggers:

- A. Burrow tunnels in the skin
- B. Infest shrubs, trees & grass
- C. Bites usually cause systemic reactions
- D. Larva release a hemolytic venom when sucking the victim's blood

7. The most commonly used local anesthetic for insect bites is:

- A. Benzyl alcohol
- B. Dibucaine
- C. Pramoxine
- D. Benzocaine

8. Use of external preparations containing antihistamines should be limited to:

- A. 1 week
- B. 3 weeks
- C. 6 months
- D. 1 month

9. The drug used in treating pediculosis is:

- A. DEET
- B. Camphor
- C. Permethrin
- D. Hydrocortisone

10. Pyrethrins act by:

- A. Disrupt sodium channels
- B. Stimulate cholinesterase
- C. Synergize butoxide
- D. Block nerve impulse transmission



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