
Caterpillars and moths

Part II. Dermatologic manifestations of encounters with Lepidoptera

Eric W. Hossler, MD
Danville, Pennsylvania

Caterpillars and moths (order Lepidoptera) are uncommonly recognized causes of adverse cutaneous reactions, such as localized stings, papular dermatitis, and urticarial wheals. These reactions are typically mild and self-limited; however, in South America, the sting of *Lonomia* caterpillars can cause a potentially fatal hemorrhagic diathesis related to massive fibrinolysis. In addition, ocular inflammation and prominent arthralgias have been reported to be caused by caterpillar exposures. Therapies for mucocutaneous reactions to Lepidoptera are largely empiric, with the exception of antivenin against *Lonomia obliqua* envenomation. Part II of this two-part series on caterpillars and moths reviews the varied symptoms caused by Lepidopteran exposures, reviews the differential diagnosis, and discusses appropriate treatment algorithms. (J Am Acad Dermatol 2010;62:13-28.)

Learning objectives: After completing this learning activity, participants should be able to recognize the most common species that cause caterpillar- and moth-related reactions, categorize the reactions based on the clinical manifestations, and choose the most appropriate therapy.

Key words: dermatitis; insect bites and stings; Lepidoptera; moths; urticaria.

Lepidoptera are one of the most diverse groups of insects, but they are an uncommon cause of human disease. Their effects on humans are as myriad as their diversity. In the first part of this two-part series, I defined the terminology related to caterpillar- and moth-related disease, reviewed the epidemiology of caterpillar and moth envenomation, and discussed known pathologic mechanisms of disease caused by these insects. Part II of this review will provide more clinical information on each clinical pattern of disease caused by Lepidoptera and provide information on the species of caterpillar or moth that is potentially responsible for each pattern. In this way, the reader may use either the clinical impression or correct identification of the offending species to guide both management and therapy. An overview of published therapies is provided at the end of this review.

From the Department of Dermatology, Geisinger Medical Center, Danville.

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Reprint requests: Eric W. Hossler, MD, Department of Dermatology, Geisinger Medical Center, 115 Woodbine Ln, Danville, PA 17822. E-mail: ewhossler@geisinger.edu.

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SYMPTOMS

Key points

- **Localized stinging reactions are caused primarily by caterpillars of three families: Saturniidae, Megalopygidae, and Limacodidae**
- **Papular urticaria and dermatitis tend to be caused by contact with furry or bristly caterpillars**
- **Urticarial wheals, angioedema, and anaphylaxis are most commonly reported with processionary caterpillars (genus *Thaumetopoea*)**
- **A hemorrhagic diathesis can result from *Lonomia* stings**
- **Moths with the ability to pierce human skin have been reported**
- **Ophthalmia nodosa results from ocular contact with caterpillar setae**
- **Dermatitis associated with prominent joint findings is reported with *Dendrolimus* and *Premolis* caterpillars**
- **Oral exposure may occur in children and is usually mild**

Cutaneous reactions to Lepidoptera come in many forms, most commonly mild stings with a papular eruption, pruritic urticarial papules and plaques, or scaly erythematous papules and plaques in exposed areas. Consequently, the differential diagnosis is

often broad, and diagnosis requires a high index of suspicion and thorough history. Patients may provide a history of caterpillar or moth exposure, and a general knowledge of the most common offending species in that area can be of great help.

Accurately classifying human reactions to encounters with Lepidoptera is difficult because of poor documentation. There are only scant publications on the subject, and those that are available lack uniformity in either scope or investigation. The great diversity of offending species along with difficulty in accurate speciation adds to the problem. In tropical areas, where the diversity of Lepidoptera far exceeds that of temperate regions, Lepidoptera may be largely unclassified, and there may be a complete lack of documented medical records in these areas. A further difficulty is that some species are capable of producing myriad adverse effects: the caterpillars of the browntail moth (*Euproctis chrysorrhoea*) are able to cause eczematous dermatitis, papular urticaria, urticarial wheals, vesicopustular eruptions, bruising, conjunctivitis, rhinitis, and possibly fatal allergic reactions.¹⁻⁴ Most species, however, primarily cause one type of reaction, and it is with this in mind that the following classification is offered: localized stings, papular urticaria or dermatitis, urticarial wheals, hemorrhagic diathesis, ophthalmia nodosa, prominent arthritis/arthritis, bite reactions, and oral exposure (Table I).

The following paragraphs and tables are organized first by predominant symptom and then by geographic location to help clinicians with accurate diagnosis and speciation.

Localized stings

In the United States, localized stinging reactions caused by caterpillars are largely due to members of three families: Saturniidae, Megalopygidae, and Limacodidae (Table II). The Saturniidae are known as silkmoths, and the strictly American subfamily Hemileucinae contains all the known stinging Saturniidae. Composed of 49 genera and approximately 670 species from Canada to Argentina and Chile,⁵ all species may be capable of stings, although the caterpillars of most species have yet to be

described. Larvae of at least seven genera (*Automeris*,^{6,7} *Hemileuca*,⁸ *Leucanella*, *Molippa*, *Dirphia*, *Cerodirphia*,⁹⁻¹¹ and *Hylesia*¹²) are known to sting.

The most well known member of the Hemileucinae is the io moth, *Automeris io* (Fig 1). It is commonly found throughout the summer from southern Canada throughout the eastern United States, and is also found as far south as Costa Rica.¹³ Contact with caterpillars causes a nettle-like stinging sensation followed by a pruritic papular-urticarial eruption that may last for hours.^{7,13} Dizziness, diaphoresis, and abdominal pain are rarely reported.¹⁴ The similar *A louisiana* can sting and is found nearly year round along the Gulf of Mexico in Louisiana, Mississippi, and Texas. Also belonging to this family is the buck moth, *Hemileuca maia* (Fig 2), which is commonly found in the eastern United

States. It causes mild to moderate stings similar to that of the io moth.⁸ In the western United States, the closely related range caterpillar (*H oliviae*) may cause localized stings. There are 16 other species of *Hemileuca* in the United States and Canada, all of which possess stinging capability.¹⁵

In the family Limacodidae, the most well known caterpillar is the saddleback (*Acharia stimulea*; Fig 3), which is common throughout the eastern United States to Texas and Florida from late summer into October.¹³ The stings are potent; contact causes intense pain and urtication or vesiculation (Fig 4).¹⁶ Less intense stings are caused by other members of the Limacodidae found in the eastern United States: *Natada nasoni*, *Parasa chloris*, *P indetermina*, *Euclea delphinii*, *Isa textula*, and *Adoneta spinuloides* (Figs 5-9).¹⁷ In Hawaii, the stinging nettle moth (*Darna pallivitta*) was introduced in 2001 from Southeast Asia. Contact causes immediate stinging and wheal formation, which may take up to 5 days to resolve.^{18,19}

In the United States, the most severe stings belong to the caterpillar of the southern flannel moth *Megalopyge opercularis* (family Megalopygidae), commonly called the puss caterpillar. It is found in the eastern United States from the mid-Atlantic states through Texas into Mexico and central America throughout the summer but especially from

CAPSULE SUMMARY

- The clinical patterns caused by caterpillars and moths are localized stinging reactions, papular urticaria and dermatitis, urticarial wheals, hemorrhagic diathesis, ophthalmia nodosa, dendrolimiasis and paramorse, bites, and oral exposure.
- The differential diagnosis for these reactions is broad, and a history of caterpillar or moth exposure is helpful in making an appropriate diagnosis.
- Treatments for these reactions remain empiric, but an effective antivenin exists for *Lonomia obliqua* stings.

Table I. Overview of Lepidopteran reactions

Reaction	Description
Localized stinging reactions	Immediate mild to severe pain that lasts hours to days; uncommonly associated with systemic symptoms
Papular urticaria and dermatitis	Mild to moderate localized pruritic papules or eczematous patches; predominantly exposed areas; may last for days
Urticarial wheals	Evanescent pruritic wheals with or without angioedema or anaphylaxis
Hemorrhagic diathesis (Lonomism)	Localized stinging reaction followed by headache, mucocutaneous hemorrhage, potentially fatal alveolar or cerebral hemorrhage, or renal failure
Ophthalmia nodosa	Acute unilateral chemosis, occasional granulomatous inflammation or uveitis
Dendrolimiasis and paramorose	Nonspecific dermatitis associated with prominent joint involvement (arthritis or arthralgias)
Bites	Rare; mild and self-limited
Oral exposure	Typically mild and self-limited lip or oral mucosal irritation

Table II. Some common caterpillars that cause localized stings

Common name	Species	Location
Io moth	<i>Automeris io</i> ^{6,7}	Southern Canada, Eastern US to the Rocky Mountains, south to Costa Rica
Buck moth	<i>Hemileuca maia</i> ⁸	Eastern US
<i>Palometia peluda</i> (little hairy pigeon)	<i>Hylesia</i> spp. ^{5,12,56,60,136-138}	Mexico, Central, and South America
Cup moth	<i>Doratifera vulnerans</i> , <i>D oxleyi</i> , and <i>D quadriguttata</i> ^{38,40}	Australia
Billygoat plum stinging caterpillar	<i>Thosea penthima</i> ³⁹	Australia
Stinging nettle caterpillar	<i>Darna pallivitta</i> ^{18,19}	Hawaii and Southeast Asia
Slug caterpillar	<i>Latoia (Parasa) lepida</i> ^{41,42}	Japan
Puss caterpillar, flannel moth caterpillar, asp, <i>bicho peludo negro</i>	<i>Megalopyge opercularis</i> and <i>M crispata</i> ²¹⁻³⁰	Southeastern US south to Central America
Gum leaf skeletonizer	<i>Uraba lugens</i> ³⁵⁻³⁸	Australia and New Zealand
Mourning cloak (US), Camberwell beauty (UK)	<i>Nymphalis antiopa</i> ^{17,47}	North America and Eurasia
Danaid eggfly	<i>Hypolimnas misippus</i> ³⁸	Southeast Asia, Africa, tropical Americas, and Australia

UK, United Kingdom; US, United States.

September through October, when the highest numbers of stings are reported.²⁰⁻²³ Caterpillars, also called “asps” or “*bicho peludo negro*,” are easily recognized by their wooly appearance and characteristic “tail” (Fig 10). There are spines hidden within the dense hair coat that cause severe burning pain, edema, erythema, and a characteristic grid-like hemorrhagic papular eruption (Fig 11).²⁴⁻²⁹ Up to one-third of victims may have systemic reactions, including lymphadenopathy, headache, acute abdominal distress, muscle spasm, faintness, vertigo, respiratory distress, swallowing difficulty, shock-like symptoms, or convulsions.^{21-23,28-30} A fascinating catalog of reported stings can be found at http://www.bugsinthenews.com/puss_caterpillar_encounters.htm.³¹ In

the northeast United States, the similar black-waved flannel moth (*M crispata*) causes a less severe sting.²⁶ Other *Megalopyge* species, including *M urens*, *M lanata*, and *M krugi*, found in Central and South America, may also be capable of severe stings.^{10,32,33} A related species, the white flannel moth (*Norape ovina*; Fig 12), causes mild stings and is found from Virginia to Missouri and across the southeastern United States.^{13,34}

In Australia and New Zealand, the gum leaf skeletonizer moth (*Uraba lugens*; Fig 13) is another member of Limacodidae whose stings cause pain, erythema, and wheal formation (Fig 14).³⁵⁻³⁸ Australia is the home of several other stinging Limacodids, including the billygoat plum stinging



Fig 1. Io moth caterpillar (*Automeris io*).



Fig 2. Buck moth caterpillar (*Hemileuca maia*).



Fig 3. Saddleback caterpillar (*Acharia stimulea*).

caterpillar (*Thosea penthima*), which can cause mild to severe stings, in one case associated with crushing chest pain.³⁹ Members of the genera *Doratifera*,^{38,40} *Microleon*, *Monema*, and *Scopelodes*¹⁷ also can cause human stings.

Reports from other continents are sparse. Two Asian Limacodids have been reported: in China, *Parasa bilarata* causes stings,³³ while the Japanese slug caterpillar *Latoia* (*Parasa*) *lepida* has caused several cases of dermatitis.^{41,42}

Papular urticaria and dermatitis

Papular urticaria and dermatitis tends to be caused by the setae from hairy or bristly caterpillars or from adult moths (Table III). Most tiger moth



Fig 4. Saddleback caterpillar envenomation: author's forearm.



Fig 5. Nason's slug (*Natada nasoni*).



Fig 6. Smaller parasa (*Parasa chloris*).

caterpillars (family Arctiidae) are woolly or fuzzy, and a number have been reported to cause mild papular pruritic dermatitis. The hickory tussock moth (*Lophocampa caryae*) is found in the United States from Maine to the Carolinas in late summer, and is easily recognized by its black and white pattern (Fig 15).¹³ Exposures cause a mildly pruritic eruption that often self resolves within an hour. Direct oral contact has occurred in children, and can cause crying, drooling, refusal to drink, and oral or lip irritation.⁴³ The great tiger moth (*Arctia caja*) grows to 6 cm in length and is covered with stiff black hairs that may cause a pruritic red scaly papular eruption.^{33,44} Several other species in the United States are less commonly reported to cause dermatitis (Table III).

The gypsy moth (*Lymantria dispar*) is a well known cause of dermatitis in the northeast United



Fig 7. Stinging rose caterpillar (*Parasa indetermina*).



Fig 10. Puss caterpillar (*Megalopyge opercularis*).



Fig 8. Spiny oak slug (*Euclea delphinii*).



Fig 11. Sting of puss caterpillar, with characteristic hemorrhagic "grid-like" appearance. (Photograph courtesy of Dirk M. Elston, MD, Geisinger Medical Center. Image is in the public domain.)



Fig 9. Crowned slug (*Isa textula*).



Fig 12. White flannel moth (*Norape ovina*).

States, where it was introduced from Europe around 1869. The caterpillars are found from May to June, and are recognized by a series of paired warts on the head, with blue and red pairs along the dorsal surface of the caterpillar (Fig 16).¹³ Contact with *L dispar* caterpillars causes a pruritic eruption variously described as papular, urticarial, or eczematous, typically most prominent in uncovered areas (Fig 17). The variability in rash morphology may be linked to the multiple pathologic mechanisms involved. The rash is self-limited, lasting approximately 4 to 7 days.^{45,46}

The white-marked tussock moth caterpillar (*Orgyia leucostigma*), with a bright red head and prominent yellow or white dorsal tufts, is one of the most easily recognizable caterpillars in the United States (Fig 18). It is found from southern Canada

south to Texas.¹³ Contact with either the caterpillar or cocoon has been reported to cause dermatitis after contact with the skin.^{17,20,47} A closely related caterpillar, the Douglas-fir tussock moth (*O pseudotsugata*) can be very common on conifer trees in the late spring in the Pacific Northwest United States.⁴⁸⁻⁵⁰ Contact with these caterpillars causes welts or papular urticaria, although sometimes dermatitis occurs.⁵⁰⁻⁵² Some series describe the eruption as simply "rash" or "itch."⁵¹

The genus *Hylesia* comprises about 110 species and is found from Mexico southward throughout South America.^{5,53,54} Female moths (Fig 19) of many species bear hollow abdominal setae^{5,12,55,56} and

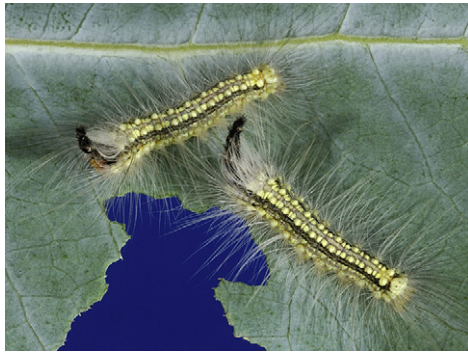


Fig 13. Gum leaf skeletonizer moth caterpillar (*Uraba lugens*). (Reprinted with permission from Scion Research, Rotorua, New Zealand.³⁵)



Fig 14. Sting of gum leaf skeletonizer moth caterpillar. (Reprinted with permission from Scion Research, Rotorua, New Zealand.³⁵)

contact with the setae on adult moths or setae deposited on egg masses causes pruritic papulourticarial or vesicular eruptions (Fig 20). In Venezuela, where the moths are called *palometa peluda* (the little hairy pigeon),⁵⁶ the rash is called Caripito itch, named after the port city of Caripito, where numerous outbreaks have been documented.^{57,58} Dermatitis may be widespread, and symptoms can continue for weeks after exposure.⁵⁶⁻⁶⁰ Even international travelers to endemic areas may return home with dermatitis from exposure to *Hylesia*.⁵⁹

In Europe, caterpillars of the browntail moth (*Euproctis chryssorrhoea*) are found from England to the Caucasus Mountains.⁶¹⁻⁶³ A small population is also found in the United States, centered around southeastern coastal Maine and Cape Cod, although the range of *E chryssorrhoea* in North America formerly extended westward to the Hudson River Valley.^{13,61} The caterpillars, which have orange or red abdominal tufts and a characteristic white lateral stripe (Fig 21), cause papulourticarial or eczematous eruptions in exposed areas (Fig 22).^{1,2} Although most reactions are mild, some are more severe,¹⁻³ and at least one death has been attributed to overwhelming allergic reaction to this insect.⁴

Two European Lasiocampids, the oak eggjar (*Lasiocampa quercus*) and small eggjar (*Eriogaster*

lanestris), have been reported to cause widespread papular urticaria after direct or indirect exposure to the caterpillar setae.⁴⁴

There are numerous Australian caterpillars that cause dermatitis. The caterpillar of the mistletoe browntail moth (*Euproctis edwardsi*) is the most common cause of caterpillar dermatitis in Australia.³⁷ Contact with larvae causes pruritic urticarial wheals or papular dermatitis that can be severe.⁶⁴⁻⁶⁶ Cocoons also bear irritating setae. The larvae are covered with long hairs, but the offending setae, which can embed in human skin, are minute and found only within a white streak along the dorsal surface of the caterpillar.⁶⁴⁻⁶⁶ A similar species found in the Northern Territory that also causes dermatitis is *E stenomorpha*.³⁷ Larvae and cocoons of the Australian white-stemmed gum moth (*Chelepteryx collesi*) bear stiff setae that can penetrate unprotected skin, causing pain, swelling, papular dermatitis, urticaria, or angioedema.^{37,38,67,68} These caterpillars grow to 10 cm in length and feed on eucalyptus.³⁸ *Anthela nicotboe* larvae have caused papular dermatitis in pine plantation workers.³⁷ The genus *Anthela* contains 50 other members in Australia, several of which are known to be urticating.³⁸ The caterpillar of the bag-shelter moth (*Ochrogaster lunifer*) is found throughout Australia and is often found in long processionary lines feeding on Acacia trees. Contact with the hairy caterpillars may cause severe papular or urticarial dermatitis or ophthalmia nodosa.^{40,69} Several other Australian caterpillars are capable of causing papular dermatitis (Table III).

In Asia, there are several species related to the browntail and mistletoe browntail moths that cause papular urticaria or dermatitis. These include the caterpillar and moth of the Asian mulberry tussock moth (*E flava*) found in China,⁷⁰⁻⁷² adult moths of *E bipunctapex* in Singapore,⁷³ the caterpillar of the Japanese tea tussock moth (*E pseudoconspersa*),^{33,74} *E flavociliata*, and *E funeralis*.³³

Reports of African Lepidoptera causing human disease are woefully inadequate. In Nigeria, adult moths of *Anaphe venata* may cause dermatitis similar to that of *Hylesia*.^{9,17,55}

Urticarial wheals

Three species of processionary caterpillars (all belong to the genus *Thaumetopoea*) cause urticaria or angioedema after contact with caterpillar setae. Two species are commonly known as the pine processionary caterpillar (*T wilkinsoni* and *T pityocampa*); both cause human exposures primarily from December to April when the caterpillars can be found feeding on pines.^{75,76} *T wilkinsoni* is found on Cyprus, Israel, Turkey, and the near east,⁷⁷ whereas

Table III. Species that cause primarily papulourticarial reactions

Common name	Species	Location
Browntail moth	<i>Euproctis chrysoorhea</i> ^{1-4,13,61-63}	Europe and the US*
Gypsy moth	<i>Lymantria dispar</i> ^{13,45,46}	Europe and the Eastern US
Hickory tussock moth	<i>Lophocampa caryae</i> ^{13,43}	US
White-marked tussock moth	<i>Orgyia leucostigma</i> ^{13,17,20,47}	Eastern US and Canada
Douglas-fir tussock moth	<i>O. pseudotsugata</i> ⁴⁸⁻⁵²	Pacific US
None	<i>Hylesia continua</i> and <i>H frigida</i> ^{5,136,137}	Mexico to Panama
<i>Palometa peluda</i> (little hairy pigeon)	<i>Hylesia metabus</i> ^{5,56,60,138}	South America
None	<i>Hylesia nigricans</i> ⁵	Argentina
Asian mulberry tussock moth	<i>Euproctis flava</i> ⁷⁰⁻⁷²	Korea, Japan, and China
None	<i>Euproctis bipunctapex</i> ⁷³	Singapore
Japanese tea tussock moth	<i>Euproctis pseudoconspersa</i> ^{33,74}	Japan
None	<i>Anthela nicothoe</i> ^{37, 38}	Australia
White-stemmed gum moth	<i>Chelepteryx collesi</i> ^{37,38,67,68}	Australia
Mistletoe browntail moth	<i>Euproctis edwardsi</i> ⁶⁴⁻⁶⁶	Australia
None	<i>Spilosoma glatingnyi</i> ^{37,38}	Australia
None	<i>Eutane terminalis</i> ^{37,38}	Australia
None	<i>Manuela replana</i> ^{37, 38}	Australia
None	<i>Panacela lewinae</i> ^{37,38}	Australia
None	<i>Orgyia (Teia) anartoides</i> ^{37,38}	Australia
None	<i>Porthesia lutea</i> ³⁸	Australia
None	<i>Acyphas leucomelas</i> ^{37,38}	Australia
None	<i>Leptocneria reducta</i> ^{37,38}	Australia
Australian bag-shelter moth	<i>Ochrogaster lunifer</i> ^{40,69}	Australia
None	<i>Anaphe venata</i> ^{9, 17, 55}	Nigeria

US, United States.

*In the United States, it is found only in the coastal regions of Maine and Massachusetts.

T pityocampa (Fig 23) is found in Britain and in Southern Europe.^{75,77,78} The oak processionary caterpillar (*T processionea*) occurs in southern and central Europe, but in contrast to its pine-feeding cousins it is found during the summer months.⁷⁹

Contact with caterpillars, cocoons, airborne setae, or soil contaminated with setae from any of these species causes urticaria or angioedema.^{75,80-85} This is consistent with the type I hypersensitivity reactions found in laboratory and clinical experimentation with processionary caterpillars.^{75,86-91} Systemic symptoms, such as vomiting, abdominal pain, hypertension, or anaphylaxis, have only rarely been reported.^{76,79,92,93} To date, no deaths have been reported in the English medical literature.

Hemorrhagic diathesis (Lonomism)

Caterpillars of *L obliqua* and *L achelous* cause localized stings that may progress to a severe hemorrhagic diathesis termed Lonomism. These gregarious and brightly colored caterpillars bear branched spines (Fig 24) and are found primarily in Brazil and Venezuela (Fig 25).⁹⁴ Since it was first reported in 1967, approximately 1000 cases have been reported.⁹⁵ After envenomation, a mild to severe burning pain occurs, often accompanied by

headache, nausea, or vomiting. During the next one to several days, cutaneous, mucosal, and visceral hemorrhage ensues (Fig 26). Frank or microscopic hematuria and renal failure may occur. Death may follow from alveolar or intracranial hemorrhage.⁹⁶⁻⁹⁹ Lemaire⁵ described 11 species of *Lonomia*; hemorrhagic diathesis was not seen after envenomation by *L electra*, but to date, stings to other species have not been reported.⁵ I advise avoiding contact with all species in this genus.

Biting moths

Six known species of moths from the genus *Calyptra* have the distinct ability to pierce mammalian skin—including that of humans—with a rasplike proboscis in order to feed on blood (Fig 27).¹⁰⁰ Although the genus *Calyptra* is widely distributed, including distribution in the United States, only species from southern and Southeast Asia and eastern Russia have been documented to bite humans.¹⁰⁰ Only male moths are known to bite.^{17,100,101} Bites from these moths are variously described as painless and transient to intensely painful with swelling that may remain until the next day. Because of the ability to pierce skin, some authors suggest a theoretical risk of transmissible disease.^{17,101}



Fig 15. Hickory tussock moth caterpillar (*Lophocampa caryae*).



Fig 18. White-marked tussock moth caterpillar (*Orgyia leucostigma*).



Fig 16. Gypsy moth caterpillar (*Lymantria dispar*).



Fig 17. Rash from contact with gypsy moth caterpillars.



Fig 19. Female *Hylesia lineata*. (Photograph courtesy of D. Janzen, PhD, and W. Hallwachs, PhD, University of Pennsylvania, Philadelphia, PA. All rights reserved.)



Fig 20. "Caripito itch" from contact with the setae of female *Hylesia* moths. (Photograph courtesy of Dirk M. Elston, MD. Image is in the public domain.)

Prominent arthritis/arthralgias

Dendrolimiasis refers to the syndrome of dermatitis and arthritis/chondritis caused by contact with the Masson pine caterpillar (genus *Dendrolimus*) found in China.¹⁰² Both caterpillars and cocoons may cause a self-limited papular or urticarial eruption associated in up to two-thirds of patients with peripheral monoarticular arthropathy that can result in joint destruction.^{102,103} Chondritis affecting the costal, thyroid, and auricular cartilages has been described. Soft tissue swelling and pain may also be present. Ophthalmitis has also been reported.^{102,103}

Pararamose is similar, with a nonspecific pruritic skin eruption associated with a potentially deforming arthritis. It is caused by contact with caterpillars,

cocoons, or imagines of the Brazilian moth *Premolis semirufa*.^{104,105}

Ophthalmia nodosa

Caterpillar and tarantula hairs can cause a toxic or allergic eye irritation called ophthalmia nodosa. Setae may be windblown, transferred to the eye via a finger or other fomite, or may result from direct ocular contact with the caterpillar. Unilateral upper lid involvement is typical and begins with chemosis



Fig 21. Browntail moth caterpillar (*Euproctis chrysorrhoea*).



Fig 22. Rash from contact with browntail moth caterpillar. (Photograph courtesy of Jan Samanek, State Phytosanitary Administration of the Czech Republic. All rights reserved.)



Fig 23. Pine processionary caterpillar (*Thaumetopoea pityocampa*). (Photograph courtesy of John H. Ghent, US Department of Agriculture, Forest Service, Bugwood.org. All rights reserved.)

immediately after exposure.^{106,107} Patients often have the sense of a foreign body. Chemosis may progress to granuloma formation, iritis, vitritis, retinitis, or endophthalmitis.^{108,109} Embedded hairs may slowly migrate to deeper areas of the eye through an unknown mechanism, eventually reaching the optic nerve in some cases.^{108,110,111} Many species (Table



Fig 24. *Lonomia* spp.



Fig 25. Distribution of *Lonomia achelous* and *L. obliqua*.

IV) have been reported to cause ophthalmia nodosa. In most reports, the offending species is not reported or cannot be identified. Any caterpillar bearing setae may have the potential to cause eye irritation.

Oral exposure

Reports of direct oral exposure to caterpillars are rare. Most cases occur in children, who demonstrate crying, drooling, and lip irritation immediately after exposure. Symptoms include dysphagia, erythema, pain, edema, and pruritus. The most common sites of exposure are the tongue and lips, although the buccal mucosa, palate, hypopharynx, and esophagus may be affected. Setae can be removed with tape stripping in most children with a resolution of the symptoms in 12 to 24 hours^{40,43,112}; however, some require admission for observation, direct laryngoscopy, bronchoscopy, and esophagoscopy in the



Fig 26. Cutaneous hemorrhage secondary to *Lonomia obliqua* sting. (Courtesy of Ronaldo Z. Mendonça and Roberto Henrique Pinto Moraes Pesq.Científico-Parasitologia/Entomologia, Instituto Butantan.)



Fig 27. *Calyptra thalictri*. (Courtesy of Branden Apitz and Jennifer M. Zaspel. All rights reserved.)

Table IV. Caterpillars known to cause ophthalmia nodosa

<i>Thaumetopoea pityocampa</i> ¹¹⁰
<i>T wilkinsoni</i> ¹³⁹
<i>Euproctis chryssorrhoea</i> ¹¹⁰
<i>Anthela</i> spp. ¹⁰⁶
<i>Hemileuca oliviae</i> ¹⁴⁰
<i>Dendrolimus punctatus</i> ¹⁴¹
<i>Ochrogaster lunifer</i> ⁶⁹
<i>Arctia caja</i> ¹²⁰
<i>Spilosoma virginica</i> ¹⁴²

operating room to remove setae embedded in the mucosae.^{43,112}

DIAGNOSIS AND DIFFERENTIAL

DIAGNOSIS

Key points

- **History of exposure is key to diagnosis**
- **Symptoms and physical examination findings of caterpillar or moth exposure are often nonspecific and the differential may be broad**
- **Geographic location and season may be helpful**

An accurate diagnosis of symptoms caused by caterpillars or moths is nearly impossible without a

reliable history of exposure. Most symptoms arising from contact with moths and caterpillars are non-specific, and differential diagnosis is broad. Papular urticaria and eczematous dermatitis are caused by a host of caterpillars and moths (Table III). The differential of papular urticaria include allergies to foods, fragrances and flavorings, medications, metals, plant substances, animal dander or products, preservatives and germicidals, and a host of other chemicals.¹¹³

Other causes of papular urticaria include dermatitis herpetiformis, folliculitis, autoeczematization, and other arthropod assaults, including scabies. The differential for eczematous dermatitis caused by caterpillars includes allergic contact dermatitis, irritant dermatitis, autoeczematization, dermatomyositis, eczema, lichen planus, lichen simplex chronicus, seborrheic dermatitis, tinea corporis, and transient acantholytic dermatosis (Grover disease).

Processionary caterpillars (genus *Thaumetopoea*) typically cause urticaria, angioedema, or anaphylaxis. Urticaria is most commonly associated with recent infection, medication, foods, chemicals, or physical stimulants. In addition, many other insect bites and stings also cause urticarial papules or wheals.

Once exposure has been documented, a focused history on geographic place of exposure can be helpful. Travel to South America, coupled with examination findings of hemorrhage or extensive bruising should trigger laboratory investigation for fibrinolysis caused by *Lonomia* envenomation. Urticarial wheals after travel to the Mediterranean or Middle East are suggestive of processionary caterpillar (*Thaumetopoea*) exposure. Acute stings from caterpillars are generally caused by slug caterpillars (Limacodidae), puss caterpillars (*Megalopyge*), or caterpillars of Hemileucinae (including the io and buck moth caterpillars). Prominent joint symptoms associated with rash after exposure to caterpillars in China is suggestive of *Dendrolimus* exposure.

There are also other clues. Symptoms related to caterpillar or moth exposure tend to occur on exposed areas. With the exception of the pine processionary caterpillar, caterpillar and moth exposures occur during the summer months, when insects are most prevalent and when people engage in more outdoor activity. However, exposure to tropical insects, especially during international travel, may occur year round. Acute, unilateral ocular inflammation is suggestive of ophthalmia nodosa, and a history of caterpillar exposure should be elicited.

Laboratory work-up in cases of Lepidoptera exposure is useful only in Lonomism. Lonomism is characterized by prolonged prothrombin time, activated partial thromboplastin time, and thrombin

Table V. Treatments for Lepidopteran exposures

Treatment category	Treatment	Level of evidence
General recommendations	Avoidance of heavily infested areas	IIIc
	Manual removal and destruction of caterpillars, cocoons, or egg nests	IIIc
	Pesticide application	IIb
	Turning off artificial lights	IIIc
	Removal of setae via forceps or cellophane tape stripping	IIc
	Immediate washing with soap and water	IIIc
	Removal of constricting clothing or jewelry	IIIc
	Laundering of contaminated clothing	IIIc
Medical therapy	Ice, topical pramoxine, or other topical anesthetics	IIIc
	Topical aspirin	IIb
	Topical, intralesional, or oral steroids	IIIc
	Oral antihistamines	IIIc
	Acetaminophen, oral narcotics, or diazepam	IIIc
	Intravenous calcium gluconate*	IIIc
	Nebulized or subcutaneous epinephrine	IIIc
Lonomism	Antivenin [†]	IIb
	Antifibrinolytics [‡]	IIIc
Ophthalmia nodosa	Removal of setae	IIIc
	Topical or oral steroids	IIIc
	Surgery	IIIc

Evidence is graded using a 3-point scale based on the quality of methodology as follows: I, good quality patient-oriented evidence; II, limited quality patient-oriented evidence; and III, other evidence including consensus guidelines, extrapolations from bench research, opinion, or case studies. Clinical recommendations are ranked as follows: A, recommendation based on consistent and good quality patient-oriented evidence; B, recommendation based on inconsistent or limited quality patient-oriented evidence; and C, recommendation based on consensus, opinion, or case studies.

*For puss caterpillar (*Megalopyge opercularis*) stings.

[†]For *Lonomia obliqua* stings.

[‡]For *Lonomia achelous* stings.

time, with characteristic reduction of fibrinogen and normal platelet level. Fibrinogen level may be a marker of disease activity in Lonomism.¹¹

PATHOLOGY

The histology of caterpillar exposure is nonspecific, typically showing epidermal edema, superficial perivascular lymphocytic infiltrate, and eosinophils.^{16,115,116} Epidermal necrosis and vasculitis are rarely seen.^{57,117,118} Embedded spines from *Hylesia* moths and caterpillars of the browntail moth (*Euproctis chrysorrhoea*) and the puss caterpillar (*Megalopyge opercularis*) have been described.^{58,117,119} Granulomas with or without embedded caterpillar hairs have been demonstrated in cases of ophthalmia nodosa.^{108,110,120} In addition, granulomas with embedded setae have been seen in both dendrolimiasis and paramorose.¹⁰³⁻¹⁰⁵

TREATMENT

Key points

- **Treatments are largely empiric and should be based on symptoms**
- **The removal of spines or hairs should be attempted**

- **Topical steroids and oral antihistamines have been used with mixed success**
- **Puss caterpillar stings may require opioid analgesia**
- **Antivenin should be used for stings caused by *L obliqua***

See Table V. With the notable exception of *L obliqua* envenomation, the treatment of adverse events from exposures to Lepidoptera remains symptomatic and supportive. The first line of treatment is the avoidance of offensive species. Heavily infested areas should be avoided by sensitive persons, and caterpillars that bear hairs or spines should not be handled without gloves. For outbreaks or infestations, the manual removal of egg or caterpillar nests or the use of pesticides may be warranted.^{53,56,64-66,71,79,121-123} Outdoor lighting should be turned off in areas where *Hylesia* moths may congregate.⁵³ For those working with Lepidoptera, rearing of caterpillars should be done in a separate room with adequate ventilation and good sanitation. Protective clothing, such as gloves and face masks, may be needed for the routine handling of insects.¹²⁴

Once contact with moths or caterpillars occurs, care should be taken not to rub or scratch the area,

nor any attempt to remove or “squash” the insect with a bare hand, because this may further spread irritating setae or spines. Instead, careful removal of the larva with forceps or similar instrument, combined with tape stripping of the area and immediate washing with soap and water, can be effective in minimizing exposure.^{14,20,64-66,79} Contaminated clothing should be removed and laundered thoroughly.^{50,52}

Stinging reactions are often mild and may respond to ice application or use of topical anesthetics, such as pramoxine 1%.^{26,29} In more severe stings, particularly after stings from puss caterpillars (*Megalopyge opercularis*), acetaminophen or narcotics may be needed.^{28,29,39} Diazepam has been used for muscle spasm caused by puss caterpillar envenomation,²⁸ and there are several case reports detailing the successful use of 10% intravenous calcium gluconate for puss caterpillar stings.^{29,30,125}

Ecematous reactions are typically treated with mid- to high-potency topical steroids.^{20,85,116,126} However, response to topical steroids is often ineffective. Topical pramoxine, camphor, or menthol preparations may be useful in these cases. Urticarial reactions may be best treated with antihistamines, and several reports document their usefulness.^{26,73,85,92} However, a number of reports document the failure of antihistamines to relieve itch.^{6,52,58,127} Strong recommendations regarding their use cannot be made; however, topical antihistamines may cause allergic contact dermatitis and should be avoided. Because histamine appears to play a role in the eruption caused by many species, topical aspirin may be effective.¹²⁸ Oral or intramuscular steroids have been useful in some cases^{20,24,126,127} and ineffective in others.¹²⁹ Anaphylaxis is rare, but should be treated with subcutaneous epinephrine in a monitored setting. Dendrolimiasis has been successfully treated with antihistamines and oral analgesia but occasionally requires surgical intervention for chondritis or pyarthrosis.¹⁰²

Ophthalmia nodosa and oral exposure should be managed by a qualified specialist. Most authors suggest immediate irrigation and the removal of setae, under sedation if needed.^{108,130} Topical steroids can be used for uveitis or iritis, although granuloma formation may necessitate surgical removal.^{108,130} Asymptomatic hairs deep within the eye that cannot easily be extracted may be observed.^{108,130} Systemic steroids and antihistamines have been used in several cases of oral exposure.¹¹²

Lonomism should be managed by an experienced hematologist. An effective antivenin against Lopap has been produced to counteract the hemorrhagic diathesis from *L obliqua* envenomation.^{131,132} It has

been successful in preventing severe hemorrhage in two large series of patients,^{133,134} and is considered the cornerstone of current therapy.⁹⁷ Stings caused by *L achelous* should be treated with cryoprecipitate, purified fibrinogen, or antifibrinolytic drugs, such as aprotinin and ϵ -aminocaproic acid.⁹⁷ It should be noted that antifibrinolytics do not work for stings caused by *L obliqua* and may exacerbate the clinical symptoms.^{132,135} Whole blood and fresh-frozen plasma may worsen hemorrhagic symptoms in stings from both species and should be avoided.^{97,135}

CONCLUSIONS

Moths and their caterpillars may cause dermatologic or systemic symptoms in humans. Many reactions go unrecognized and may be difficult to diagnose based on their nonspecific symptoms. Dermatitis, urticaria, and localized stings are the most common reactions; however, angioedema, ocular and oral symptoms, anaphylaxis, joint involvement, and hemorrhage may develop. Most therapies are empiric and symptom-driven. An effective antivenin exists for *L obliqua* envenomation.

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