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Caterpillar-Borne Abortions in Pregnant Mares and Camels

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Summary: The caterpillars are the larval forms of butterflies and moths in the order Lepidoptera. While some species are insectivorous, most of them are herbivorous. As known voracious feeders, caterpillars are pests in agriculture, and damage to fruits and other agricultural products. In addition, moths and their larval stages have medical and veterinary importance because of their behaviors and noxious secretions. Some groups of moths in Lepidoptera adapted for feeding directly on secretions and body fluids of animals and humans. These butterflies known as zoophilic moths feed on animal fluids such as lachrymal secretions, blood and skin exudates on wounds, nasal secretions, saliva, perspiration, urine and droplets of blood dripped from mosquitoes feeding on host animals. Further, some skin-piercing moths preferentially attract to open wounds on animal hosts and suck blood. During the feeding, the moths play a role as mechanic vectors for some infections in endemic regions. On the other hand, some urticating caterpillars in the order Lepidoptera such as Limacodidae, Megalopygidae and Saturniidae cause urticaria and moth dermatitis in human, the majority of caterpillars within the families Lasiocampidae, Notodontidae, Thaumetopoidae, and Lymantriidae induce equine abortions in pregnant mares and also in dromedary camels due to ingestion of the larval forms during grazing in the infested area. The caterpillar-borne abortions in pregnant mares and camels were reviewed in this article.

Key Words: Abortion, camel, caterpillar-borne, mare, pregnancy

Gebe Kısrak ve Develerde Tırtıl-Kaynaklı Abortlar

Özet: Tırtıllar Lepidoptera dizisinde yer alan kelebeklerin larval formlarıdır. Bazı türlerin tırtılları insektlerle beslenirken çoğunluğu herbivordur. Doymak nedir bilmeyen tırtıllar, esasen tarım haşereleri olup meyvelere ve diğer tarımsal ürünlere zarar verirler. Buna ilaveten bazı gece kelebekleri (güveler) ve onların larval dönemleri, davranış özellikleri dolayısıyla medikal ve veteriner öneme sahiptirler. Lepidoptera dizisindeki gece kelebeklerinin bir bölümü direkt olarak hayvan ve insanların vücut sıvıları ve sekresyonlarıyla beslenmeye adapte olmuşlardır. Zoophilic güveler olarak da adlandırılan bu kelebek türleri hayvanların gözyaşı sekresyonları, yaralar üzerindeki kan ve deri eksudatları, burun sekresyonu, tükürük, ter ve idrar gibi vücut sıvılarıyla ve konak hayvanlardan kan emen sivrisineklerden dökülen kan damlacıklarıyla beslenirler. Ayrıca deriyi delebilme ağız yapısına sahip bazı güveler tercihen açık yaralara saldırırlar ve konak hayvanların kanlarıyla beslenirler. Beslenme süresince güveler endemik bölgelerde bazı enfeksiyonların mekanik vektörlüğünde rol oynarlar. Diğer yandan, Lepidoptera dizisinde bulunan Limacodidae, Megalopygidae ve Saturniidae ailelerindeki bazı türler insanlarda ürtiker ve güve dermatitisine sebep olurken, Lasiocampidae, Notodontidae, Thaumetopoidae ve Lymantriidae ailelerindeki kelebek tırtılları, enfeste alanlarda otlama esnasında yemlerle alınmaları sonucu gebe kısrak ve develerde yavru atmalara yol açarlar. Bu derlemede gebe kısrak ve develerde tırtıl kaynaklı abortlar hakkında bilgi verilmiştir.

Anahtar Sözcükler: Abort, deve, gebelik, kısrak, tırtıl-kaynaklı

Introduction

In phylum of arthropoda, eight orders of insects [Blattaria (cockroaches), Phthiraptera (lice), Hemiptera (true bugs, bed bugs, kissing bugs, assian bugs), Coleoptera (beetles), Siphoneptera (fleas), Diptera (Flies: mosquitoes, black flies, biting midges, horse flies, deer flies, sand flies, tsetse flies, house flies, stable flies, horn flies, bot flies, blow flies, flesh flies, louse flies, keds, etc.), Hymenoptera (wasps, hornets, velvet ants, ants and bees) and Lepidoptera (butterflies, skipper butterflies and moth-butterflies)] and four orders of arachnids [(Scorpionida (scorpions), Solpugida (solpugids, sun spiders, camel spiders and barrel spiders), Acari (mites and ticks) and Araneae (spiders)] have medical and veterinary importance as mechanical and biological vectors of pathogens such as virus, bacteria, fungus and parasites. However these vectors cause very serious problems like annoyance, toxication, allergic reactions, invasion of host tissues in humans and also in animals (8, 13-15).

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Of these arthropod groups, the order Lepidoptera includes the butterflies and moths, and has a holometabolous (complete metamorphosis) life cycle. The adults feed primarily on nectar from flowers and exhibit excellent natural beauties with their wonderful colors depending on their lifestyles. Butterflies and moths play an important role in the natural ecosystem as pollinators and as nutrients in the food chain. Conversely, their larval stages are considered very problematic to vegetation in agriculture as their main source of food is often live plant matter. On the other hand, some lepidopteran species are recognized as economic pests of row crops, fruit and shade trees, ornamental shrubs, and other plantings on which their larvae feed. In addition, a number of lepidopteran species, notably moths can cause significant health problems for humans and animals. A few groups of moths have adaptation for feeding directly on secretions and body fluids of animals and humans. Zoophilic moths feed on animal fluids such as lachrymal secretions, blood and skin exudates on wounds, nasal secretions, saliva, perspiration, urine, and droplets of blood extracted from mosquitoes feeding on host animals. Furthermore, some skin-piercing moths preferentially attract to open wounds on animal hosts and suck blood (8, 13-15).

Lachrymal feeding: Some adult moths frequently ingest liquids (lachrymal secretions, or tears) from the mucous membrane margins of the eyes of domestic or wild animals, and sometimes eye exudates, and even sweat from humans. This activity is most common during dry periods of the year. Lachrymal feeding has been observed mainly in Southeast Asia (Cambodia, Indonesia, Laos, Malaysia, and Thailand), but a number of cases have also been reported from Africa, China, and the United States (at least one case in Arkansas). The moths mainly limit this feeding activity to evening or early night hours, or very rarely during the day in deeply shaded forest or jungle sites. So far, this behavior has been reported for >100 moth species, representing at least 25 genera, in at least 6 families (Geometridae, Noctuidae, Notodontidae, Pyralidae, Sphingidae, and Thyatiridae). This activity can be a serious nuisance to animals and might spread ocular pathogens (2).

Blood feeding: Adults moths in some of the above groups will occasionally feed on blood or other fluids seeping from open sores, scratches or wounds. Unique to Southeast Asia (Indonesia, Laos, Malaysia, and Thailand), a number of species of the noctuid genus *Calyptra* can, and often do, directly pierce the unbroken skin of animals or humans and ingest fresh blood. Animals from which they have been observed to take blood include elephants, Malayan tapir, deer, water buffalo, rhinoceros, antelopes, mules, and pigs. At least five species in this genus (*C. bicolor*, *C. fasciata*, *C. ophideroides*, *C. parva*, and *C. pseudobicolor*) have been reported to feed on humans (2).

Beside a group of lepidopteran species cause some serious disorders in humans such as caterpillar sittings (*Premolis semirrufa*) in field workers in tropical countries, moth dermatitis (*Hylesia* spp.), inhalation allergies (*Hylesia* spp.) and silk-induced allergies (*Bombyx mori* and *B. mandarina*), some other groups notably skin-piercing moths have the potential to transmission of some contaminants and pathogens as mechanic vectors. For instance, during the feeding, the moths play a role as mechanic vectors for some infections such as Infectious Bovine Keratitis (IBK), or “Pinkeye” in cattle in the endemic regions of Uganda and some moths also serve as intermediate hosts for the rat tapeworm *Hymenolepis diminuta* (20).

In addition, larval stages of moths have medical and veterinary importance due to their natural behaviors in the habitats. For example while some urticating larval stages of Limacodidae, Megalopygidae and Saturniidae in the order of Lepidoptera cause urticaria and moth dermatitis in humans and domestic animals due to their noxious fluids e.g. formic acid (16), the majority within the families Lasiocampidae, Notodontidae, Thaumetopoidae, and Lymantriidae induce equine abortions in pregnant mares and also in dromedary camels due to ingestion of the larval forms during grazing in the infested area in the world (20). Currently some lepidopteran species have already been identified in the families Limacodidae (4 species), Saturniidae (6 species), Lasiocampidae (30 species), Notodontidae (34 species), Thaumetopoidae (5 species), and Lymantriidae (21 species) in Turkey (1).

The larval forms of butterflies and moths in the order Lepidoptera are called “caterpillar”. While some species are insectivorous, most of the caterpillars are herbivorous. As known voracious feeders, caterpillars are pests in agriculture, and damage to fruits and other agricultural products. However, caterpillars are very important pests notably for horse and camel breeding in some parts of the world (20). The caterpillars inducing abortions in pregnant mares (12, 22, 26, 27), and

camels (4, 32) have been reported from some parts of the world. The caterpillar-borne abortions were first described as mare reproductive loss syndrome (MRLS) in the United States (23), and equine amnionitis early fetal loss (EAEFL or EFL) and late fetal loss (LFL) in Australia (21, 22, 31).

Caterpillar-Borne Abortion in Pregnant Mares and Economical Losses: Pregnancy loss is a major cause of wastage in equine breeding industry. Other possible causes such as infectious (viral and bacterial), noninfectious (twin pregnancy, progesterone deficiency, umbilical cord torsion, congenital defects) and unusual causes have already been reported in pregnant mares (17). In the last decade, many unusual abortions have been detected in pregnant mares in several parts of the world (21, 26). Tobin and Brewer (28) reported that the first observations about the unusual abortions in pregnant mares have been identified on April the 26th 2001 by Thomas Little. Little observed an unexpected number of in uteri deaths in 60 day-old fetuses in clinically normal mares when he was ultra sounding for sex determination in Central Kentucky in 2001, United States, and the cases were described as MRLS depend on the clinic pathological features of the abortions. The definition of the MRLS cases were mainly described in two different forms and also associated with some pathological characteristics as identified below:

i. Early fetal loss (EFL): The observations about the EFL were recorded within 35 and 100 days after mares were bred. During the ultrasound examination of mares in this period, fetal death was detected after expulsion of the fetus was associated with the presence of abnormal echogenic fluid (cloudy and flocculent) around the fetus (24).

ii. Late fetal loss (LFL): The LFL cases were observed as abortions during the last trimester of the pregnancy in mares. Late fetal loss was not associated with cases, it was associated with a swollen and engorged placenta (premature placental separation or “red bag” syndrome). Foals born alive were sometimes weak and required intensive veterinary care (5).

iii. The observation: The increased echogenicity of fetal fluid after day 85 in ultrosonographic exams of mares was one of the clinical parameters for identification of EFL (26, 30).

iv. In addition to reproductive losses, a number of cases of pericarditis (inflammation within the sac surrounding the heart) and severe unilateral uveitis (inflammation of one eye) were associated with the occurrence of MRLS (6).

Epidemiologically significant factors associated with EFL were reported as the presence of moderate to high concentrations of eastern tent caterpillars (ETC) in grazing areas, farm population of greater than 50 mares, the presence of barren or maiden mares in the effected fields, mares bred in February 2001, the presence of wild cherry trees around mare pastures, and the frequent presence of waterfowl on the farm (9, 10). It has also been reported that a concurrent relation was observed between the high incidence of MRLS cases and a population explosion of the ETC (*Malacosoma* spp and *Datana* spp) localized areas in a year (11, 33, 34). Currently, twenty-six species of tent caterpillars (*Malacosoma*: Lasiocampidae) have been identified in the northern latitudes of both the New and Old World (20). On the other hand, it was reported that the syndrome was associated with certain caterpillars within the families Thaumetopoeidae (*Ochrogaster*) and Lymantriidae (*Euprctis, Leptocneria*) in Australia (21).

It was stated that the abortigenic factor that initiates the syndrome may be a toxin in integument and setae of caterpillars (7, 18). The ETC follows (i) the ingestion of caterpillars (in fodder or forage) by pregnant mares, (ii) the penetration the intestinal wall, and (iii) entering the blood stream. From the bloodstream they can be carried to various tissues and organs, including the developing fetuses of pregnant mares. Evidence indicates that normally nonpathogenic bacteria in the gastrointestinal tract (e.g. alpha *Streptococcus* spp. and *Actinobacillus* spp.) are transported by the setal fragments of caterpillars and can infect reproductive tissues, and umbilical cord. At the end of the caterpillar-induced poisoning process, the fetal deaths and abortions may occur (11, 26). In addition, the caterpillar-induced poisoning process was demonstrated by experimental studies in the United States (3, 18, 19, 25) and Australia (7) where intubating mares in mid-pregnancy with preparations of either whole processionary caterpillars or shed caterpillar exoskeletons induced abortion with few impending clinical signs. The gross pathological and bacteriological findings of the aborted fetuses were similar to those observed in field cases of EFL (7).

The Economic Impacts of MRLS: The largest epidemic of equine abortion in North America was observed in 2001 and 2002 when more than 1500 cases were reported on horse farms in Kentucky.

Thoroughbreds were affected the most, with estimated economic losses of $330 to $500 million during the two-year period (27). The cause was attributed to the ingestion of eastern tent caterpillar (*Malacosoma americanum*) crawling on the ground after feeding on nearby heavily infested trees. Mullen (20) reported that a similar syndrome occurred in Florida in 2005, where an equine abortion occurred in mares following the ingestion of a walnut caterpillar (*Datana integerrima*), due to severe defoliation of hickory trees. Similar economic losses have also been reported in thoroughbred and quarter horse broodmares in Australia, involving caterpillars of three species *Ochrogaster lunifer*, *Euproctis edwardsi* and *Leptocneria reducta* (21).

Caterpillar-Borne Abortions in Camels: In camelid veterinary practice, the uterine infections and abortions are the major complain. Some factors such as infertility, pregnancy loss, udder diseases and neonatal mortality cause reproductive losses in camelids (29). According to camel breeders, the etiological reasons of abortions vary. They claim the ingested caterpillars and cobwebs in fodder on pastures may cause abortions in camels in some areas of Africa (4). Recently, it has been reported that ingestion of caterpillars (*Lasiocampa* spp.) with forage is recognized as the cause of abortions in camels in the Western Sahara in Africa (32).

In Turkey, caterpillar-borne abortions or caterpillar -induced poisoning cases in animals have not been reported yet. However, some lepidopteran species in the moth fauna may have risky potentials for caterpillar-borne abortions or caterpillar-induced poisoning in livestock animals such as horse, sheep, goats, cattle and camel in some infested areas of Turkey, depending on climatic conditions, planting and the management of animals by pastoralists. Thus, the epidemiological investigations and monitoring studies are required for caterpillar-borne abortions in pregnant mares and camels in Turkey.

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