

A Review on Equine Onchocerciasis

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Abstract: Onchocerciasis is a disease caused by filarial nematode that belongs to the genus *Onchocerca*. Though Onchocerciasis is an important filarial infection in human, most species in domestic animals are relatively harmless. Equine Onchocerciasis has worldwide distribution. The three important species affecting equine are; *O. cervicalis*, *O. reticulata* and *O. raillieti*. All the three species that occur in equine are elongated white worms and have typical morphological characters. Each species has its own predilection site and their life cycles are indirect with *Culicoides* as IH. The prevalence of *Onchocerca* spp infection in horse increases with age. A form of cutaneous Onchocerciasis is seen in donkeys in Africa which causes severe ulceration in the withers and neck region of donkeys. The possible causative species is *O. raillieti*.

Key words: Biting insect • Microfilaria • Onchocerca • Skin

INTRODUCTION

Equine Onchocerciasis is a parasitic disease of horses, with world-wide distribution, caused by a filarial worm of the genus *Onchocerca*. Under this genus, there are three most common species in equine: *Onchocerca cervicalis* (*O. cervicalis*), *Onchocerca reticulata* (*O. reticulata*) and *Onchocerca raillieti* (*O. raillieti*). The adults of *Onchocerca cervicalis* are found in the ligamentous tissue adjacent to the nuchal attachment of the thoracic vertebral spinous processes and in and around the supraspinous bursa [1].

Onchocerca cervicalis is a filarial nematode, the adults of which live as coiled in the ligamentous nuchae of the horse. Large numbers of microfilariae are produced by the adult females and reside in the dermis, having migrated via the connective tissue. The ventral abdomen, thorax, withers, neck and face are the sites in which microfilariae are commonly found [2].

The most common parasite connected with uveitis is *onchocerca cervicalis*. *Culicoides*, a biting midge of the Ceratopogonidae family, is believed to be the primary transmitter. The adult lives in the connective tissue of the horse's neck and the microfilariae travel throughout the body. The most common signs of it are sores breaking out on the midline of the horse's stomach, base of the mane

and withers and uveitis in the horse's eye(s). Uveitis occurs when there are large quantities of dead microfilariae in the eye. Normally the eye can handle the live ones but the dead worms give off large amounts of antigens and these cause inflammation in the eye. Conjunctiva biopsy can be used to identify *Onchocerca* microfilariae in the eye, but it requires auriculopalpebral nerve block and topical anesthesia [3].

Onchocerca cervicalis has been associated with fistulous withers, poll evil, dermatitis and uveitis in horses. However, because a large number of the parasites are present in horses without these symptoms, there is some debate about its role in the pathogenesis of these conditions. The differential diagnosis for cutaneous Onchocerciasis includes dermatophytosis, fly-bite dermatoses, mite infestation and food hypersensitivity [4]. The objectives of this seminar paper are to review the life cycle, epidemiology and clinical signs of equine Onchocerciasis and to update the knowledge on diagnosis, treatment, control of equine Onchocerciasis and to suggest suitable recommendations.

Equine Onchocerciasis: Onchocerciasis is a disease of cattle, equine, buffalo, humans, sheep, dog and camel. It is in the African continent that the largest species of *onchocerca* is encountered [5].

Etiology: Onchocerciasis is a disease caused by filarial nematode that belongs to genus *Onchocerca*. The most common etiological agents that affects equines are; *O. cervicalis*, *O. reticulata* and *O. raillieti*. *O. reticulata* is the most pathogenic species causing chronic inflammation of the suspensory ligament of fetlock of flexor tendons chiefly of fore legs. The microfilaria has more pathological side effects than the adult parasite and causes Onchocercal dermatitis at the site of localization [6].

Taxonomic Classification:

- Phylum- *Nemathelminthes*,
- Family-*Onchocercidae*,
- Subfamily-*Onchocercinae*,
- Genus-*Onchocerca*,
- Species -*O. cervicalis*, *O. reticulata*, *O. raillieti* [6].

Morphology: The worm are intricately coiled, the female being over 5-15 times longer than male.. The size varies according to spp of the parasite. The cuticle shows transversal striations and spiral thickenings, which are often interrupted in lateral fields. At the posterior portions of the filarial parts males show papillae and spicules. Two extremities of the body are obuse. The tail of the male is curved and bears several papillae and two unequal and dissimilar spicules. The microfilariae of *O. reticulata* has a tapering tail and are much longer (310-395µm) than those *O. cervicalis* (210-250µm) [5].

O. cervicalis has a maximum width (mm) of 360–570µm. Ridges are prominent, shape of striae is teeth-like, Striae per ridges are 3–44:1. Similarly, *O. reticulata* in horse the maximum width is 275–400µm and shape of striae is triangular, Striae per ridges are 1-120:1 (Sreter and Szelles, 2007). The microfilaria is 200-240µm in length and with short 6 tails [7].

Life Cycle: Several spp of *culicoides* have been identified as IH depending on the region: *C.parotti*, *C.robersti* and *C.varripennis*. During the meal, the *culicoides* ingest dermatotropic microfilaria from infected animal. The microfilaria spend 3 to 4 days in the digestive tract of *culicoides* before migrating towards the thoracic muscle and then the larvae reach the haemocoel after 7 days. The infecting larvae reach the proboscis between 2 to 4 weeks post infection. They leave the proboscis and penetrate the definitive host actively, via the bite of the insect. The larvae migrate and develop to adult worms in the predilection sites. In horses, *O. cervicalis* adult localize in nuchal ligament and *O. reticulata* in suspensory ligament of fetlock [5].

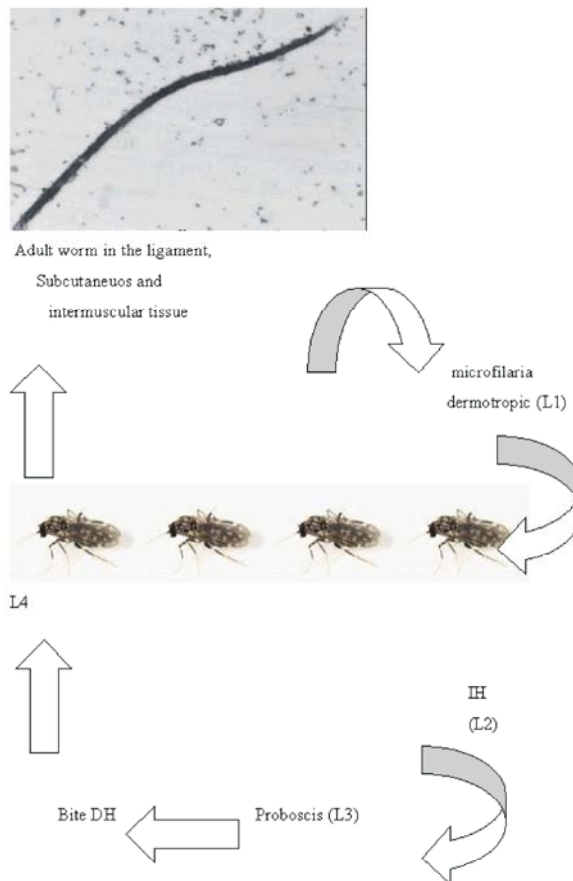


Fig. 1: Life cycle of equine *onchocerca*[6]

Filarial nematode produce modified first stage larvae called microfilaria that enter blood or lodge in skin of the definitive hosts, where they are available to arthropods that serve as IH and vectors. They have broad feeding preferences and infective larvae can be transmitted to a variety of vertebrates other than those to which they are adapted [8].

O. reticulata in the flexor tendons and suspensory ligaments requires an intermediate host and use midges (*Culicoides* sp.), as an arthropod vector. Biting midges pickup the microfilaria which occurs in the skin of horses and these develop to an infective stage in the midge in about 3 weeks. When the midge takes a blood meal from a horse, the infective stage is injected thus completing the cycle [2].

Epidemiology: *O. cervicalis* and *O. reticulata* are found worldwide in horse, mules and donkeys whereas *O. raillieti* occurs only in donkeys in Africa. In some regions, such as in Texas it is found. The general prevalence of equine Onchocerciasis is high [6].

Table 1: Different species of *Onchocerca*, their distribution and localization

Species	DH	IH	Localizations	Geographical distributions
<i>O. cervicalis</i>	Equine	<i>Culicoides</i>	Ligament nuchae	Worldwide
<i>O. reticulata</i>	Equine	<i>Culicoides</i>	Flexor tendons and suspensory ligament	Worldwide
<i>O. railleiti</i>	Donkey	unknown	Subcutaneous tissue	Africa

Source: [5,11].

Cutaneous Onchocerciasis is common on horses in the United States of America. In fact, many surveys carried out there showed that about 20 to 100 % of horses are *Onchocerca* microfilariae carriers. These results are also found in Australia. In France few epidemiological studies indicated that almost 6% of horses living in Cam argue had *Onchocerca* microfilariae whereas just one percent of French horses examined were positive [9].

Onchocerca cervicalis has been reported from the Midwestern, western and eastern United States. Although Canadian reports are few, *Onchocerca* infections have been reported from Quebec. This report documents the existence of cutaneous Onchocerciasis in southwestern British Columbia. Horses with five years old had few or no lesions, whereas most horses of six to 15 years old had focal mineralization and granuloma formation around adult worms [2].

The microfilaria population in the skin varies and the highest concentration occurs in the dermis of neck, face and ventral mid line, especially the umbilicus. The microfilaria populations vary seasonally and are highest during spring, which interestingly is the peak season for *culicoides* vector. Microfilaria are more superficial in the dermis during spring and summer months [10].

The incidence of infection is high ranging from 10% in young horses to 90% in horses over 16 years of age. The lesions are also apparent in older horses and are described as mineralization and granuloma formation [12].

Pathogenesis: A number of *Onchocerca* spp lie in ligament, where they cause inflammation and significant discomfort to the host. For example, *O. cervicalis* occurs in the ligament nuchal, the large ligament, that insert at the back of the head and support it. The parasite causes inflammation of ligament and then necrosis of the connective fiber and calcification later in the infection [13].

A form of cutaneous Onchocerciasis is seen in donkeys in Africa and possibly another nearby areas which causes severe ulceration in the withers and neck region of donkeys; the adult parasite (sometimes extractable by hand) causes this problem. The possible causative species is *O railleiti*. The degree of reaction

appeared to be related to parasite degeneration. Blood vessels around the granulomas were undergoing obliterating arthritis. A large acellular area of coagulative necrosis involving the parasitic tunnels was seen. Dead microfilariae were scattered in these areas. Bands of fibrous tissue invaded the ligament isolating its fascicles [14].

The presence of *O. Cervicalis* microfilariae in the tissues can lead to dermatitis. If the eye is invaded, ocular lesions and blindness can result. Many horses harbor the parasite without signs of the disease (Lees, 1983). Ocular lesions are initiated by dead microfilariae rather than by living microfilariae [15].

Onchocerca cervicalis is a worm that lives in the ligament nuchal or thick, fibrous, supporting structure of the neck muscles in horses. The adult worms produce microfilaria that migrates through the connective tissue to the skin of the belly midline, face and eyes. When this microfilaria die, the body's inflammatory response produces swelling and redness followed by ulceration. The horse may experience itching, oozing and crusting of lesions, resulting in loss of hair and skin pigment. If the microfilariae migrating through the eye die, they can result in multiple eye problems [16].

The microfilaria travel in the blood stream and congregate within the skin layers of the upper neck, head, chest and under-belly. They are ingested by biting insects, *Culicoides spp*, which cause secondary intense itching. The congregation of allergic microfilaria results in the development of small discreet raised lumps about the size between a pea and a marble. Itching causes rubbing and thinning of the hair, breaking the skin, resulting in serum matting and scab formation on the skin and the hair. This attracts more insects and flies. Often the mane is rubbed off. In severe cases, the damage to the hair follicles under the lesions results in bald patches over thickened fibrous nodules on the neck under the mane and in strips along the under-belly [17].

The adult parasite of *O. cervicalis* and *O. railleiti* are non- pathogenic and cause few problems. However *O.reculata* infections in the flexor tendons and suspensory ligament may cause lameness. A seasonal, sporadic dermatitis is known to occur in many parts of the

world due to the presences of microfilariae. The reaction may be induced by both microfilaria (dead and dying once) in the dermis and the bite of insects. Microfilaria also accumulate in the eyes of horse but there is still some debate about their role in the pathogenesis of equine uveitis [18].

Clinical Signs: *Onchocerca* microfilaria have been incriminated as causing pathological changes (periodic ophthalmia and blindness) in the eyes of horse. Ocular Onchocerciasis in the horse has been termed as periodic ophthalmia. Periodic ophthalmia was manifested by recurrent attacks of keratitis, conjunctivitis, kerato-uveitis and anterior uveitis. However, microfilaria may be found in apparently normal eyes and it has not been conclusively proved that *Onchocerca* spp are involved in periodic ophthalmia in horses [7].

In normal eyes and it has not been conclusively proved that *Onchocerca* species causes sensitivity to light, horses will squint or hold eyelid only half open, swollen eyelids, watery, teary eyes, excessive blinking, spasms of the eye muscles, constricted pupils (small pupils), cloudy eye, lethargic muscle tenderness, loss of appetite, increased thirst, dehydration, small pupil, yellowing of the whites of the eyes [19].

Adult *O. cervicalis*, which are located in the nuchal ligament serve as a predisposing factor for local inflammatory reactions followed by purulent lesions that are the cause for fistulous wither or poll evil [20].

O. reticulata is highly pathogenic, causing chronic inflammation of the suspensory ligament of fet lock or flexor tendons chiefly of the forelegs and less commonly of knee and shoulders. The lesions take the form of swellings and nodules consisting of fibrous tissues which may be calcified. The animal develops lameness due to compression of the palmer nerves or by mechanical constrains on the movement of tendon. In race and sport horses, lameness leads to cessation of activities. The microfilaria causes Onchocercal dermatitis at the site of localization of the parasite or other locations (face, neck, ventral part of the abdomen), during transportation. The lesions are papular and exudative in nature [5].

The clinical signs may include alopecia, erythema, crusting with or without pruritus; It must be differentiated from hyper sensitivity reaction to biting flies [21].

Apart from the initial mild reaction no clinical signs attributable to adult worms have been demonstrated. The microfilaria are reported to cause chronic dermatitis, being severe in summer and disappearing during winter [6].

Multiple oblong areas of encrustations, alopecia and hyper pigmentation ranging in size from 2-4 cm in diameter were present on the forehead and below the ears, continuing onto the throat area. A 10cm x 2 cm area on the chest is also involved. The uninfected nuchal ligaments showed an irregular arrangement of lamellar fibers grouped in bundles and separated by connective tissue septa. *Onchocerca* sp.-infected nuchal ligaments had a multifocal distribution of parasites between fibers with an inflammatory response that varied from little or no reactivity in horses under five years old to advanced fibroplasia and mineralization in horses over 16 years old. Chronic lesions were characterized by granulomas with caseous centers surrounded by epithelioid cells, lymphocytes and multinucleated giant cells. Ultimately the inflammation progressed to fibroplasias with mineralization and calcium deposition [1].

Diagnosis: To diagnose the presence of Onchocerciasis, skin biopsy is macerated, allowed to incubate in saline and examined microscopically for the presence of microfilaria. Microfilaria may also be seen in histological preparation of skin biopsies [22].

A piece of skin is placed in warm saline for about 8-12 hours and teased to allow emergence of the microfilaria. These are readily recognized by their sinuous movements in centrifuged sample of the saline. Fluid from scarified area can also be examined for the presence of microfilaria [6].

Alternatively, the epidermis may be shaved off at skin site and the fluid expressed examined for microfilaria. In the eye microfilaria may be detected by ophthalmological examination. (Soulsby, 1982). [15] found the most constant source of microfilariae to be the stroma of the cornea adjacent to the limbus in the upper quadrant. A snip or biopsy of conjunctiva may be taken from here and examined.

The clinical diagnosis of equine Onchocerciasis is based on observation of non-seasonal dermatitis associated with the microfilaria in the dermis, localization of lesions and symptoms of lameness. The therapeutic diagnosis can be based on the microfilaricide efficacy following the treatment of the animal. Nevertheless the saliva of *culicoides* injected via bite during feeding can induce hypersensitivity reaction in some animals causing cutaneous dermatitis. This non-specific dermatitis (summer itch) which is seasonal and affects only some allergic individuals should be differentiated from Onchocercal dermatitis by detecting the presence of microfilaria in skin sample [5].

Differential Diagnosis: *Onchocerca* infections of living animals is identified by morphology of the mf from skin rather than by examination of adult worms. Multiple infections by several filarial spp are very common. The location of mf and adult worms in skin and body is more or less spp-specific, but may vary with the biting behavior of local vector and also depend on the adult worm load. Microfilaria may accumulate in those body sites that favored feeding sites of the vector. Maximum numbers of mf are observed at times, seasonally and diurnally [23].

The differential diagnosis for cutaneous Onchocerciasis includes dermatophytosis, fly-bite dermatoses, mite infestation and food hypersensitivity [4].

Setaria species is the differential diagnosis for *Onchocerca* spp. In the *setaria* spp the larvae is sheathed whereas the larvae of *onchocerca* is unsheathed [18].

Skin diseases are also complex and have a variety of causes besides external parasites. For example, modern medicine recognizes such diverse causes as infection, diet, contact with irritant or allergenic substances, allergies, hereditary and auto-immune disease [24].

The *culicoides* bite during feeding can induce hypersensitivity reaction causing cutaneous dermatitis should be differentiated from Onchocercal dermatitis by detecting the microfilaria [5].

Treatment: Diethylcarbamazine is microfilaricidal and is used both in man and horse. 5-8mg/kg is given daily for 21 days. Systemic corticosteroids will suppress the mazzotti reaction in the skin and should be applied topically or subconjunctivally. Horse with uveitis shouldn't be treated until the inflammation has subsided. Metrifonate suppress microfilaraemia and triclophan has been used with success in horse. Dihydroivermectin B1 against microfilaria of *O. cervicalis* at the dose of 0.2-0.5mg/kg is given by intramuscular injection [7].

Levamisole at 11mg/ kg once daily for seven to ten days is advised orally and intramuscularly. Prednisone was given orally at a dose of 600 mg. Levamisole appears to have a lethal effect on the microfilariae only. Therefore, it is imperative to caution owners that repeat treatment, as frequently as once in every three months. Both the oral and injectable Levamisole seem to be safe form of therapy. Diethylcarbamazine has been recommended as the treatment of choice for Onchocerciasis. Its filaricidal effect has been widely accepted but never proven. It now appears that in many horses it acts mainly by virtue of its anti-inflammatory effect and is often not lethal to microfilaria [2].

Horses with dermatitis, alopecia and pruritus associated with the microfilaria of *O. Cervicalis* can be treated with a single intramuscular injection of ivermectin of 0.2mg/kg of body weight. After medication with some time the infected horse become edematous. However, this reaction to dead microfilaria subsided over the next few days. Moxidectin at 0.3-0.5mg/kg also will eliminate the microfilaria from infected horse. Onchocerciasis can be treated systemically with ivermectin. Since the disease is believed to be due to the continuous death of the microfilaria, killing large numbers of microfilaria at once will give the horse a break from the disease. But horse owners should exercise caution in the use of ivermectin if the horse is having eye problems along with the skin problems. Ivermectin will kill (eliminate) the microfilaria from infected horse [25].

Prevention and Control: The prevention and control of Onchocerciasis is difficult; Insecticides and repellents reduce the attacks of insects and to minimize the risk of transmission of infection [6].

Currently there is no horse vaccine that has been 'approved but there are some old timer vets' in some area, who routinely vaccinated horses with the cattle vaccine. Cattle vaccine that had been used on horses has since been changed and that horses have a painful reaction at the injection site with the new version. Because the vaccine is not specifically approved for horses, many vets either will not use it, or require the horse owner to sign a release of liability to protect the horse [19].

Control of biting insects is essential to prevent the condition, stable and rug the horse day and night, install insect screens in stable during summer months. Control of the microfilaria that cause skin itching can be achieved by deworming with equimax, equiminth, equimec or equest. The itch may controlled by predinisolone granules added to the feed for 3-5 days [26].

The parent worm, which develops in the neck ligaments 4-5 months following contamination with infective microfilaria introduced by biting insects, cannot be controlled effectively within its protective environment deep within the neck ligament. Once a horse becomes infected, it will have repeated seasonal recurrence of microfilaria-induced itching. The circulating and congregated microfilaria can be controlled by 'mectin' worming compounds administered when the lesions are active and itchy [21]. There is often a severe itching reaction triggered by the immune system by the dying microfilaria within the skin lesions, causing self-mutilation

by rubbing. This reaction normally occurs in heavily infected horses within 24-36 hours after worming with 'mectin' wormer. In case where the itching is so intense so as to cause severe skin damage, injection of corticosteroid may be recommended [17].

CONCLUSION

Generally, equine onchocerciasis is a parasitic infection of horses with world-wide distribution, caused by a filarial worm of the genus *Onchocerca*. The three important species affecting equine are; *O. cervicalis*, *O. Reticulata* and *O. railletii*.

All the three species that occur in equine are elongated white worms and have typical morphological characters. A number of *onchocerca* spp lie in ligament, where they cause inflammation and significant discomfort to the host. The adult parasite of *O. cervicalis* and *O. reticulata* are non- pathogenic and cause few problems. However, *O. reticulata* infections in the flexor tendons and suspensory ligament may be associated with lameness. Sporadic dermatitis is known to occur in many parts of the world due to the presences of mf of *onchocerca*.

A form of cutaneous Onchocerciasis is seen in donkeys in Africa and possibly in other nearby areas which causes severe ulceration in the withers and neck region of donkeys; it is the adult parasite that causes this problem. The possible causative species is *O railletii*. This *nematode* also requires an intermediate host and use midges (*Culicoides* sp.) as an arthropod vector. Biting midges pickup the microfilaria which occurs in the skin of horses and these develop to an infective stage in the midge in about 3 weeks.

Several spp of *culicoides* have been identified as IH depending on the region: *C.parotti*, *C.robersti* and *C.varripennis*. The microfilariae *Onchocerca cervicalis* are capable of producing a variety of lesions in the equine eye. Ocular lesions are initiated by dead, rather than living microfilariae. The clinical features of diseases of the conjunctiva, cornea, uveal tract, lens and retina produced by this parasite are described, together with methods of their diagnosis and treatment. Adult *O. cervicalis*, which are located in the nuchal ligament serve as a predisposing factor for local inflammatory reactions followed by purulent lesions for the cause of fistulous wither or poll evil. *O. reticulata* is highly pathogenic, causing chronic inflammation of the suspensory ligament of fetlock or flexor tendons chiefly of the forelegs. Cutaneous

Onchocerciasis can affect horses; adult forms and larvae of *Onchocerca* are responsible for the trouble. The prevention and control of Onchocerciasis is difficult; Insecticides and repellents reduce the attacks of insects and to minimize the risk of transmission of infection. Based on the above conclusion the following recommendations are forwarded.

- Horses more than 5 years of age requires special attention as they are more susceptible to parasitic infection and more risk of developing disease.
- Confirmed and common signs should be understood in case of cutaneous Onchocerciasis to differentiate from other multiple skin infections.
- The infection of Onchocerciasis can be reduced by purchasing young or newborn horses from other areas.
- Proven vaccination and other prevention mechanisms should be followed to reduce the spread of the disease.
- The modified treatment should be prepared since Ivermectin is not recommended for adult parasites.
- Prevention and control mechanism should be focused on the intermediate hosts.

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