



## Research Article

### Parasitic Encephalomyelitis in Goats due to Aberrant Infestation with Botfly *Oestrus ovis* Larvae

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#### ABSTRACT

Nasal myiasis or oestrosis is primarily a disease of sheep (but rarely in goats, camel, deer, dog and man) caused by the infestation of nasal cavities by the larvae of botfly *Oestrus ovis*. Four adult goats, aged between three and five years were presented with clinical history of onset of episodes of neurological symptoms such as ataxia, staggering gait, convulsions, circling and paddling of legs. The animals were treated but the response to the treatment was very poor. The severity of neurological signs increased with time resulting in recumbency and death of the animals. On necropsy, 19 larvae were recovered from the nasal sinuses and cranial cavity of one animal, 4 from brain of another goat and one larva each from the brain of other two animals. The *Oestrus ovis* larvae were confirmed based on the presence of posterior 'D' shaped respiratory spiracles. These very rare cases of aberrant infestation of goat brain with *Oestrus ovis* larvae, their clinical manifestation, pathology and public health significance have been described and discussed in detail.

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#### INTRODUCTION

Oestrosis, also known as nasal myiasis, is a worldwide disease of animals caused by the larvae of botfly, *Oestrus ovis* (Linne 1761, Diptera: Oestridae), are obligatory parasites of the nasal and sinus cavities of sheep and goats (Gunalan et al., 2011; da Silva et al., 2012; 2013 Hanan, 2013). The parasite primarily infests sheep but rarely infests goats, camel, deer, reindeer, elk, ibex, dog and man (Lapage, 1956; Soulsby, 1982; Das and Bhatia, 1994). Infection occurs due to deposition of eggs by adult fly in the nostrils of the host. Infestation of *O. ovis* is usually not life threatening, but occasionally there is bacterial infection that causes encephalitis and death of the host. Secondary infections often lead to mucopurulent discharge, respiratory distress and sneezing fits in the affected animals (Urquhart et al., 2003). Nervous form of *O. ovis* infestation in sheep and goats is quite infrequent. Rarely, these larvae penetrate into ethmoid bones and reach cranial cavity resulting in abnormal neurological signs such as a high-stepping gait, incoordination and occasional death (Radostits et al., 2007; Shivasharanappa et al., 2011). Neurological signs usually mimic the infection of *Coenurus cerebralis* because of which this disease is also known as 'False Gid'. The present documentation reports rare cases of aberrant infestation of goat brain with migrating *O. ovis* larvae resulting in sudden

onset of episodes of neurological signs and fatal parasitic encephalomyelitis.

#### MATERIALS AND METHODS

##### *History and Clinical Examination*

Four adult goats aged between three and five years were presented to the Division of Animal Health of the Institute with a history of onset of episodes of neurological signs such as ataxia, staggering gait, convulsions, circling and paddling of legs. Clinical examination of the animals revealed subnormal body temperature (97– 98°F), pale conjunctival mucus membrane and poor body condition. Vital signs including heart and respiratory rates were normal. Cerebrospinal fluid (CSF) collected from the lumbosacral region was found to be turbid with pleocytosis, elevated level of total proteins (80–90 mg/dl) and reduced glucose level (25–30.8 mg/dl). Differential leukocyte count showed lymphocytosis and neutropenia. Bacteriological examination of CSF and blood was negative. Faecal examination revealed mixed infections of gastro-intestinal nematodes, *Moniezia*, and *Coccidia*.

##### *Treatment and Response to Treatment*

In all the four animals, treatment was instituted immediately after brief clinical examination as warranted by the acuteness of the condition. Treatment with Sulphadiazine and Trimethoprim combination (Biotrim®) @ 15 mg/Kg BW I/M, Dexamethasone (Dexona®) @ 5 mg/Kg BW I/M and supplementation with vitamin B1, pyridoxine

hydrochloride and cyanocobalamine, Neuroxin- 12V®) resulted in slight improvement in the condition. Despite therapy, episodes of neurological signs increased with time, the animal became laterally recumbent and finally succumbed to the disease within three to five days of the initiation of treatment.

#### Post-Mortem Examination and Sample Collection



Figure 1: *Oestrous ovis* larvae feeding on brain-parenchyma in the paranasal sinuses

#### RESULTS

On necropsy of one of the four animals, grossly, a total of 19 larvae were recovered, 14 from the paranasal sinuses and 5 from the cranial cavity (Figure 1). Detailed examination of cranial cavity showed severely damaged brain showing necrotic encephalomalacic and haemorrhagic lesions in the cerebral hemispheres. The left cerebral hemisphere was almost absent and liquefactive as it was completely destroyed by the migrating larvae (Figure 2). The larvae 1 to

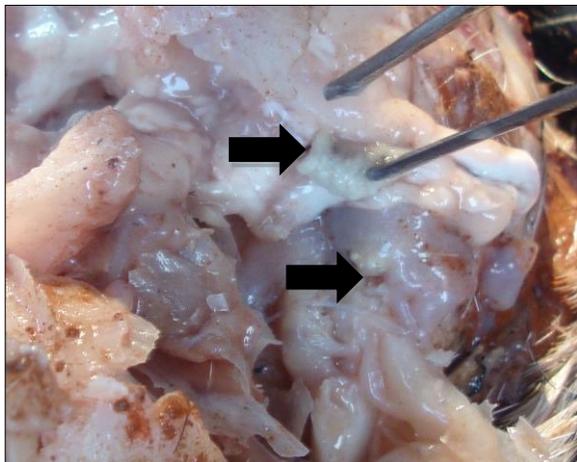


Figure 3: Brain: focused area of Figure 2, showing presence of larvae embedded in the brain parenchyma (arrows)

Histopathological examination of the brain tissue revealed multiple haemorrhagic tracts containing necrotic tissue debris, erythrocytes and inflammatory cells mostly

All four goats were necropsied thoroughly immediately after death and macroscopic observations including in the nasal, paranasal sinuses and cranial cavities were recorded. The live larvae were carefully removed from the nasal cavities, paranasal sinuses and the brain, and collected in PBS for further morphological examinations grossly as well as under stereoscopic microscope (Soulsby, 1982). The brain was collected in 10% formol saline for histopathological investigation.

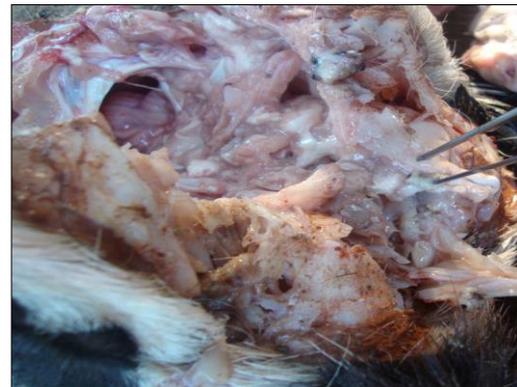


Figure 2: Brain: liquefactive necrosis of left side of brain due to *Oestrous ovis* larvae infestation. A larva embedded in the brain parenchyma is indicated by forceps tip

3 cm long, creamy, dark brown or blackish in colour, having characteristic dark pigmented respiratory spiracles were seen partially embedded in the necrotic brain parenchyma (Figure 3). Similarly, in the second goat, four larvae were found in the brain parenchyma. In the other two goats, single larva was found in the left cerebral hemisphere. No specific lesions were observed in any other organ systems. In all the four cases, nasal cavity was explored for larvae but no larvae were found.

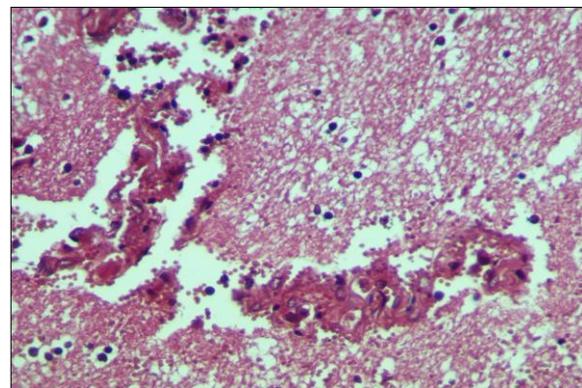


Figure 4: Haemorrhagic tracts in the brain parenchyma, showing damaged neuropil with presence of necrotic tissue debris, extravasated erythrocytes, infiltration of inflammatory cells due to migration of *Oestrus ovis* larvae. H&E x400

mononuclear cells and a few neutrophils/ eosinophils (Figure 4). Detailed microscopic examination of the recovered larvae revealed transverse bands on dorsal surface

of each segment, anterior end was armed with minute paired hooks, posteriorly connected with cephalo-thoraxial skeleton and ventral surface had rows of minute spines. The larvae were confirmed as *O. ovis* on the basis of 'D' shaped, closed, dark brown coloured, deep stigmal plates with radially arranged respiratory holes (Figure 5). Based on the history, clinical signs, laboratory findings, necropsy and pathological findings, these cases were diagnosed as parasitic encephalomyelitis due to aberrant migration of *Oestrus ovis* larvae with apparent secondary complications.



Figure 5: D-shaped closed, dark black coloured, stigmal plates with radially arranged respiratory holes

## DISCUSSION

Infection of *O. ovis* occurs due to deposition of eggs by adult fly in and around the nostrils. The larvae enter the nasal passage where they remain and develop through the second instar. The third instar larvae enter the head sinuses and remain there for 8–10 months. The larvae usually attain full size in late winter or spring and leave the sinuses to pupate. When the third instar larvae reaches the nasal passages, the host sneezes violently thus ejecting the larvae with great force (Soulsby, 1982; Marquardt et al., 2000; Taylor, 2007). The adult larvipositing *O. ovis* has a short lifespan of just two weeks and is known to possess affinity for its natural host sheep (Godara et al., 2010). Infection rates and larval burdens are always higher in sheep than in goats after either natural or artificial infestation (Duranton et al., 1996; Dorchies et al., 2000; Papadopoulos et al., 2001; 2006).

In the present study, all four cases of goats were reared together with sheep in mixed flocks owned by farmers. In India, the farmers generally rear sheep and goats together (Pathak, 1992). Although *O. ovis* is primarily a parasite of domestic sheep, other hosts like goats, man, dogs, camels are sometimes infected (Soulsby, 1982; Das and Bhatia, 1994; Abdel-Aziz et al., 2010). In a mixed flock, botfly can also have easy access to infect goats although infection rates and larval burdens of sheep are always significantly higher than goats (Papadopoulos et al., 2001; 2006). Papadopoulos et al. (2006) observed significantly higher infection rates of *O. ovis* in sheep than goats when compared seroprevalence of *O. ovis* in mixed flocks. Perhaps, due to close contact of sheep and goats the *O. ovis* fly deposited its larvae on the face or nostrils of the goat.

During their life cycle, the *O. ovis* larvae migrate to the dorsal turbinates and frontal sinuses where they remain for

few months before they migrate to nostrils and are sneezed out to pupate on the ground (Radostits et al., 2007). Interestingly, it is important to note that one seldom sees more than a single third instar larva in the head sinus. It seems that there is a feed-back mechanism that limits the occupation of a relatively limited space in the natural host sheep (Marquardt et al., 2000). Whether such feed-back mechanism is also at work in the uncharacteristic host goat is not yet known, and probably the absence of this may be the reason that, in the present study, a total of 19 larvae, 14 from paranasal sinuses and 5 from cranial cavity were recovered in one case, while 4 larvae were present in the brain of another case. Normally *O. ovis* larvae are confined to the nasal cavities and paranasal sinuses of the head. It is very rare and unusual to find such a large number of larvae in the cranial cavity and brain. These larvae might have penetrated into ethmoid bones and reached cranial cavity. These migrating larvae were either feeding on the brain parenchyma and had eaten nearly half of the brain in one case or caused traumatic injury and haemorrhages with consequent secondary bacterial infection leading to liquefactive necrosis and lysis of the half of the brain, as seen grossly and microscopically in the present study. It has been observed that *O. ovis* larvae are not hematophagous, and usually feed on plasma proteins, antibodies, secreted from the nasal mucosa during inflammatory reaction, mucin, and collagen of the basal membrane which they digest through proteases in their excretory/secretory products (Tabouret et al., 2003; Angulo-Valadez et al., 2010). The episodes of abnormal neurological signs in the affected goat were caused due to the injury to the brain parenchyma by the migration of *O. ovis* larvae. Microscopic lesions in the brain showed multiple haemorrhagic tracts with infiltration of inflammatory cells and necrosis of parenchyma (neuropil) due to migration of larvae. Mechanical activity of oral hooks and spines as well as and the proteolytic enzymes present in the secretory and excretory products of these larvae were responsible for these changes in the brain (Tabouret et al., 2003). Such irreversible damage to the brain parenchyma resulted in severe form of motor abnormalities such as ataxia, convulsions, paddling of legs and incoordination in the affected goats.

In unnatural hosts, in addition to the nares the flies oviposit on the conjunctiva of the eye, mouth and ear canal. Generally, the infection in unnatural hosts is self-limiting, but a few cases have been recorded in which first, second and third instar larvae have been removed from aberrant locations like eye and head (Marquardt et al., 2000; Abdel-Aziz et al., 2010). Infestation and recovery of *O. ovis* larvae from the aberrant sites in nonspecific and uncharacteristic hosts (ungulates, man and dog) have been reported from the eyes, eyelids, orbital tissues, mucosal cavity and lips (Hall and Smith, 1993; Abdel-Aziz et al., 2010). However, infestation and recovery of the nasal bots of sheep from the aberrant sites like cranial cavity and brain is very unusual and quite rare with the only one traceable report in a goat (Shivasharanappa et al., 2011). This report documenting four cases of aberrant infestation of goat brain by *O. ovis* larvae in such a large number contributes significantly to the scarce literature on the subject.

Oestrosis in small ruminants causes widespread morbidity and sometimes mortality which in turn results in

heavy economic losses to sheep and goat rearers (Pathak, 1992). Public health significance of *O. ovis* infestation cannot be undermined as it is associated with human population, when bots are deposited on the aberrant sites causing catarrhal conjunctivitis, corneal opacity, visual impairment (ophtho-mo-myiasis) and even stomatitis in different regions of the world (Hall and Smith 1993; Soulsby 1982; Urquhart et al., 2003; Taylor, 2007; Abdel-Aziz et al., 2010). Prevention and control of oestrosis assumes greater significance owing to its public health significance and association of goat owners from economically and socially weaker sections of the Indian society. There is an urgent need to initiate *O. ovis* control strategies in the endemic regions. Closantel @7.5 mg/Kg BW and macrocyclic lactones such as ivermectin @ 0.2 mg/Kg BW are effective (Dorchies et al., 2001) in controlling the build-up of heavy infestations and for the removal of overwintering larvae of *O. ovis*. However, treatment is not effective once the larvae migrate and reach the aberrant locations like the cranial cavity.

Based on these findings we conclude that usually these larvae are confined to the nasal cavities and sinuses of the head. It is very rare and unusual to find these larvae in the cranial cavity and brain. Hence, in these four cases of goats, abnormal neurological signs resulted due to damage caused by the migrating *Oestrus ovis* larvae and such clinical signs can be easily confused with that of viral/bacterial (meningo) encephalomyelitis.

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#### CONFLICT OF INTEREST

The authors do not have any conflict of interests, whatsoever.

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