Human Ophthalmomyiasis Interna Caused by *Hypoderma tarandi,* Northern Canada

Philippe R.S. Lagacé-Wiens,* Ravi Dookeran,* Stuart Skinner,* Richard Leicht,* Douglas D. Colwell,† and Terry D. Galloway*

Human myiasis caused by bot flies of nonhuman animals is rare but may be increasing. The treatment of choice is laser photocoagulation or vitrectomy with larva removal and intraocular steroids. Ophthalmomyiasis caused by *Hypoderma* spp. should be recognized as a potentially reversible cause of vision loss.

Ophthalmomyiasis interna is invasion of the globe by larvae of any species of oestrid flies; ophthalmomyiasis externa involves only the external ocular structures (*1*). *Dermatobia hominis,* endemic to tropical or subtropical areas, and *Oestrus ovis* (sheep bot fly) cause most cases of ophthalmomyiasis (*2*). Both typically cause ophthalmomyiasis externa (*2*). Only 2 bot flies inhabit Nearctic circumpolar regions: the Caribou bot fly (*Hypoderma tarandi*) and the Caribou nasal bot fly (*Cephenemyia trompe*), a nonhuman pathogen (*2*). *H. tarandi* is a nonbiting fly whose obligate endoparasitic larvae typically affect caribou throughout their circumpolar range (*2,3*). From late June to early September. the fly lays eggs directly on the guard hairs of the caribou (*2,3*). Once deposited, eggs hatch into larvae that penetrate skin (*3*). They move subcutaneously to reach the animal's dorsal region, where they cut breathing holes and are encased within granulomatous cysts, termed warbles. There they develop for 9–11 months; in May or June of the following year, they leave the animal and pupate on the ground (*3*). Mated adult females are capable of long flights (≈900 km) in search of suitable hosts (*3*).

Infestations by *H. tarandi* in humans are rare but are likely underreported (*4*). Related species, *H. bovis* and *H. lineatum,* inhabit various regions of North America, Europe, and Asia and have also been implicated in human disease (*2,5*). A third species that affects cattle and yaks in China (*H. sinense*) is also responsible for human infestations (*2*). The pathophysiology of human ophthalmomyiasis

*University of Manitoba, Winnipeg, Manitoba, Canada; and †Agriculture and Agri-food Canada, Lethbridge, Alberta, Canada

by *Hypoderma* spp. is not known. Eyebrows and eyelashes have been suggested as possible targets for oviposition (*3*). Oviposition on human scalp hair has been achieved experimentally and could be the preferential site in humans (*3*). An alternative explanation is transfer of the larvae directly from the guard hairs of the caribou to the human eye or skin through close contact with animal pelts. The parasite does not appear to complete its life cycle in humans (*1,2*).

We present the first, to our knowledge, 2 published cases of ophthalmomyiasis interna caused by *H. tarandi* in Canada. Furthermore, we present the first published use of *Hypoderma* spp. serologic testing to assist in the diagnosis of myiasis in humans.

The Cases and Literature Review

The first patient was a 41-year-old woman from Rankin Inlet, Nunavut, Canada, who noticed floaters (objects in the field of vision that originate in the vitreous) in her right eye in August 2006. Initial funduscopic examination showed posterior vitreous detachment. Two weeks later, her vision was more impaired; repeat funduscopy showed panuveitis. Pretreatment blood count was within normal limits with no eosinophilia. Topical steroids were ineffective. At a third assessment, her visual acuity was 20/400; funduscopic examination showed an intraocular larva (Figure 1). The parasite appeared to recede behind the retina and could not be photocoagulated. A pars plana vitrectomy and intraocular laser treatment of the entry and exit sites were performed. Triamcinolone (0.4 mg) was administered for intraocular inflammation, and antibiotics were given as prophylaxis. The larva was not recovered. Postoperative magnetic resonance imaging demonstrated no parasite or abnormality. The larva was assumed to be that of *H. tarandi* because of its appearance (shape, size, and segments), the late summer timing, and the patient's residence in the subArctic. Serologic testing for *H. tarandi* by Western blot, as described by Baron and Colwell, was performed (*6*). Six weeks after symptom onset, serum was positive for immunoglobulin (Ig) G, IgE, and IgM to hypodermin C, a larval collagenase of *H. tarandi* (*7*). No seroreactivity to the hypodermins A and B of *H. lineatum* was observed. Because the larva was unrecoverable, the patient was treated with 1 oral dose (9 mg) of ivermectin (Merck & Co., Kirkland, Quebec, Canada) 1 week after vitrectomy. After 6 months, her visual acuity had improved to 20/30.

The second patient was an 11-year-old Inuit boy from Chesterfield Inlet, Nunavut, Canada, who was examined in October 1997 because of a painful right eye, scleral redness, and blurry vision. Examination found uveitis and glaucoma. Topical steroid therapy was begun, after which retinal detachment, hemorrhages, and a 4-mm larva in the subretinal space were noted. Blood work showed marginal eosinophilia; computed tomography examination of the
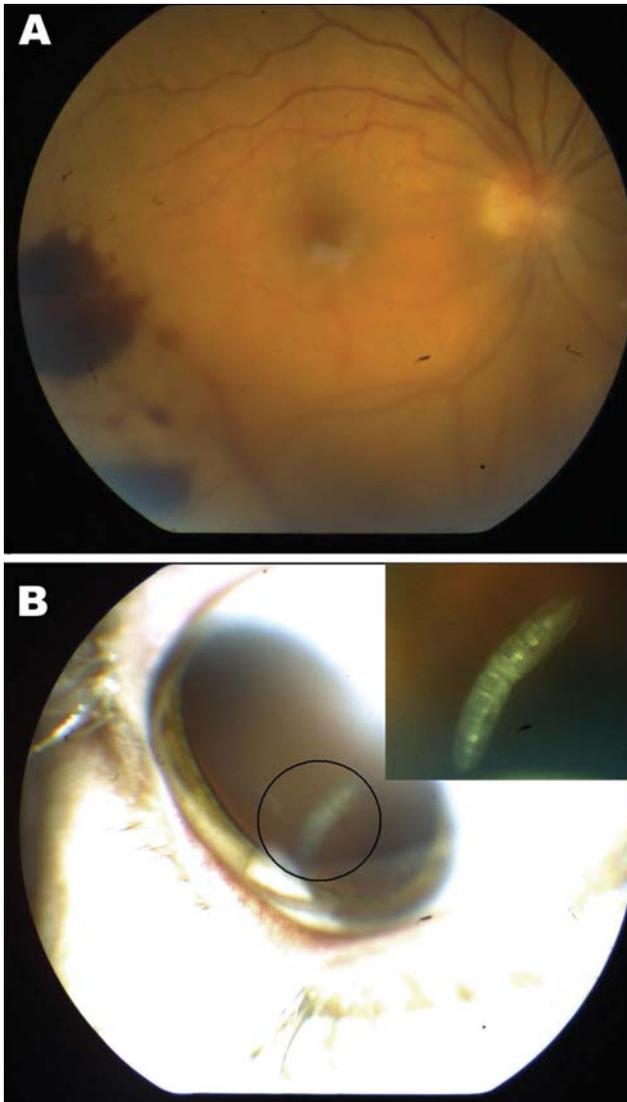
Figure 1. A) Retinal hemorrhages visible on funduscopic examination of right eye of a 41-year-old woman, Nunavut, Canada, with ophthalmomyiasis interna. B) Segmented 3-mm larva with a cylindrical body, no visible spines, and indistinguishable anterior and posterior ends in the vitreous cavity, corresponding to the first instar of *Hypoderma tarandi*.

therapy, and his eye was enucleated. Pathologic examination showed retinal detachment, eosinophilic choroiditis, and retinitis. Chronic nongranulomatous inflammation was noted in the ciliary body and iris. No additional larvae were found.

We searched the literature, using PubMed, for the terms "ophthalmomyiasis" with limits "human" and "English." We also reviewed references of selected publications. We reviewed only cases of ophthalmomyiasis interna caused by oestrid flies found in North America, which were confirmed by visible larvae (online Appendix Table, available from www.cdc.gov/EID/content/14/1/64-appT.htm). Demographics and clinical presentation of patients are in the Table. For statistical analysis, outcomes were separated into good (vision unchanged from baseline or better than 20/80), moderate (able to see shapes or fingers or vision worse than 20/80 but not blind), and severe (able only to see light or movement, completely blind or enucleated). Although moderate or severe vision loss appeared to occur more commonly with *Hypoderma* than *Cuterebra* infestations (53.3% vs 14.3%), this frequency was not statistically significant (p = 0.08). Photocoagulation appeared
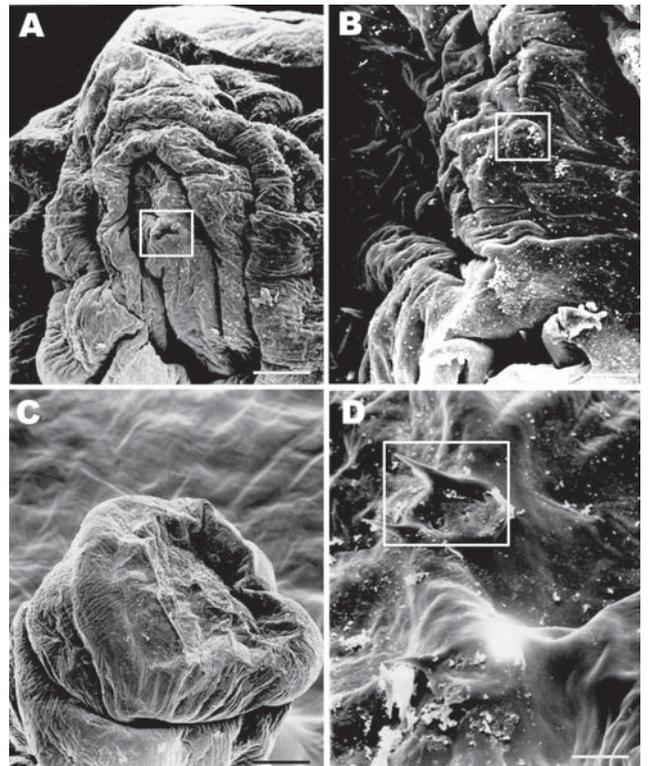

Figure 2. Scanning electron microscope images of the parasite from an 11-year-old Inuit boy, Nunavut, Canada. A) Anterior end of the maggot. The cephalic segment is evident; mouth and mouth hooks are present (boxed). Scale bar = 50 μm. B) The characteristic cephalic sensory array (boxed). Scale bar = 10 μm. C) Posterior segments of the maggot. Scale bar = 100 μm. D) Spiracular openings on the posterior segments of the maggot characteristic of first instar of *Hypoderma*. Scale bar = 10 μm.

brain and orbits showed no abnormalities. The larva was removed by pars plana vitrectomy and retinotomy. Examination of the larva by dissection microscopy showed a 4 × 1–mm larva. Scanning electron microscopy, performed according to Colwell et al. (*8*), confirmed the characteristic of the first instar of *Hypoderma* spp., i.e., mouth hooks, anterior sensory structure, spines, and spiracles (Figure 2). The presence of only 2 lateral spines per spiracle indicated *H. tarandi*. Western blot testing showed the presence of IgG only to hypodermin C. When asked about his exposure to caribou, the boy admitted to tracking, hunting, and skinning caribou. The patient's disease progressed despite

Table. Demographics and clinical presentation of 32 patients with ophthalmomyiasis interna*

Characteristic	No. (%)
Symptom	
Red eye	21 (60)
Vision loss	24 (68)
Floaters	24 (68)
Eye pain	6 (17)
Scotomas	3 (9)
Sex	
Male	27 (77)
Female	7 (20)
Loss of vision	
Severe or total†	12 (34)
Moderate	2 (6)
Mild or none	19 (54)

*Patients identified during literature search and described in the online Appendix Table. Mean patient age was 25.2 y; median, 16 y.
†Includes blindness caused by enucleation.

to produce better outcomes (80% good outcomes) than no intervention (73.7% good outcomes) or surgical removal/vitrectomy (41.2% good outcomes); however, χ^2 analysis showed no statistically significant difference (p = 0.121). This observation may suggest that by the time the patient seeks treatment, damage to ocular structures has already occurred. Recent cases have been treated with photocoagulation or vitrectomy and intraocular steroid administration. Although no specific intervention is associated with better outcomes, given the difficulty in studying outcomes in this rare condition and the success of this therapy for other foreign bodies in the eye, this course of action is reasonable. Ivermectin as medical therapy for ophthalmomyiasis interna has not been reported, but it is effective as therapy and prophylaxis for bot fly infestation of livestock (9). Ivermectin as adjunctive therapy in select cases of ophthalmomyiasis may be of benefit, but evidence is lacking. Only 1 case of ophthalmomyiasis externa caused by *D. hominis* and treated with ivermectin has been reported (10).

Conclusions

Human myiasis caused by bot flies of nonhuman animals is rarely reported. However, diagnoses may increase as a result of increasing population in northern latitudes, encroachment into habitats with natural hosts like caribou, and better access to ophthalmologists. The treatment of choice seems to be laser photocoagulation or vitrectomy with larva removal and coadministration of intraocular steroids. In areas where *Hypoderma* spp. are common, health-

care providers should consider this condition and promptly refer patients to an ophthalmologist.

Dr Lagacé-Wiens is a fellow in the department of Medical Microbiology and Infectious Diseases at the University of Manitoba in Winnipeg, Canada. His interests are parasitic and tropical diseases, antimicrobial drug resistance, and infectious diseases.

References

1. Syrdalen P, Nitter T, Mehl R. Ophthalmomyiasis interna posterior: report of case caused by the reindeer warble fly larva and review of previous reported cases. Br J Ophthalmol. 1982;66:589–93.
2. Anderson JR. Oestrid myiasis of humans. In: Colwell DD, Hall MJ, Scholl PJ, editors. The oestrid flies—biology, host-parasite relationships, impact and management. Oxford (UK): CABI Publishing; 2006. p. 359.
3. Kearney MS, Nilssen AC, Lyslo A, Syrdalen P, Dannevig L. Ophthalmomyiasis caused by the reindeer warble fly larva. J Clin Pathol. 1991;44:276–84.
4. Forman AR, Cruess AF, Benson WE. Ophthalmomyiasis treated by argon-laser photocoagulation. Retina. 1984;4:163–5.
5. Custis PH, Pakalnis VA, Klintworth GK, Anderson WB Jr, Machemer R. Posterior internal ophthalmomyiasis. Identification of a surgically removed *Cuterebra* larva by scanning electron microscopy. Ophthalmology. 1983;90:1583–90.
6. Baron RW, Colwell DD. Enhanced resistance to cattle grub infestation (*Hypoderma lineatum* de Vill.) in calves immunized with purified hypodermin A, B and C plus monophosphoryl lipid A (MPL). Vet Parasitol. 1991;38:185–97.
7. Baron RW, Colwell DD. Mammalian immune responses to myiasis. Parasitol Today. 1991;7:353–5.
8. Colwell DD, Otranto D, Horak IG. Comparative scanning electron microscopy of third instars of six *Gasterophilus* species. Med Vet Entomol. 2007;21:255–64.
9. Colwell DD, Panadero-Fontan R, Lopez-Sandez C, Parra-Fernandez F, Paz-Silva A, Sanchez-Andrade R, et al. Effect of treatment on the dynamics of circulating hypodermin C in cattle naturally infested with *Hypoderma lineatum* (Diptera: Oestridae). Vet Parasitol. 2003;113:263–72.
10. Wakamatsu TH, Pierre-Filho PT. Ophthalmomyiasis externa caused by *Dermatobia hominis:* a successful treatment with oral ivermectin. Eye. 2006;20:1088–90.

Address for correspondence: Philippe R.S. Lagacé-Wiens, Department of Medical Microbiology and Infectious Disease, 543-720 William Ave, Winnipeg, Manitoba, Canada R3E 0W3; email: csplw@mts.net or plagacewiens@hotmail.com

Search past issues of EID at www.cdc.gov/eid

Appendix Table. Reported cases of ophthalmomyiasis caused by North American oestrid flies (Diptera:Oestridae)

Reference	Year of case	Patient age (y), sex	Fly species	Residence	Signs and symptons	Treatment	Vision loss
This Article	2006	41, F	*Hypoderma tarandi*	Canada	Visual loss, red eye.	Vitrectomy, steroids, ivermectin	Mild
(*1.*)	2003	3, F	*H. bovis*	Turkey	Painful red eye	Vitrectomy, larva removal	Lost to follow-up
(**2.**)	2000	41, M	*Cuterebra* spp.	USA	Blurred vision, scotoma	Photocoagulation, steroids	Mild
This article	1997	11, M	*H. tarandi*	Canada	Visual loss, red eye	Vitrectomy, removal of larva, steroids	Enucleation
(**3.**)	1997	53, M	Unknown	USA	Vision loss	Vitrectomy, larva removal	Severe
(**4.**)	1995	14, M	*Cuterebra* sp.	USA	Visual loss	Vitrectomy, removal of larva	Mild
(**5.**)	1995	16, M	Unknown	USA	Pain, red eye, vision loss	Photocoagulation of larva	Mild
(*6.*)	1990	50, M	*Cuterebra* sp.	USA	Scotoma, vision loss	Laser photocoagulation	Mild
(*7.*)	1988	31, M	Unknown	USA	None	Vitrectomy, removal of larva	Complete recovery
(*8.*)	1986	5, F	*H. tarandi*	The Netherlands	Pain, red eye, vision loss	Vitrectomy, silicone oil	Severe
(**9.**)	1986	77, M	*H. tarandi*	Sweden	Vision loss	Vitrectomy, removal of larva	Severe
(**10.**)	1985	10, M	*H. tarandi*	Norway	Red eye	Vitrectomy, steroids, larva removal	Moderate
(**10.**)	1985	43, M	*H. tarandi*	Sweden	Red eye, vision loss	Steroids, vitrectomy, larva removal	Complete recovery
(**11.**)	1984	2, F	*Hypoderma* spp.	USA	Red eye	Vitrectomy	Mild
(**12.**)	1984	16, F	Unknown	USA	Vision loss, pain, red eye	Lidocaine, laser coagulation	Complete recovery
(**10.**)	1983	9, M	*H. tarandi*	Norway	Red eye, vision loss	Vitrectomy, steroids	Enucleation
(**13.**)	1983	33, M	*Cuterebra* sp.	USA	Red eye	Steroids	Complete recovery
(**14.**)	1983	9, M	*H. tarandi*	Norway	Visual loss, red eye	Vitrectomy	Enucleation
(*10.*)	1981	7, M	*H. tarandi*	Norway	Red eye, vision loss	Vitrectomy, larva removal, steroids	Nearly complete blindness
(*15.*)	1981	33, M	Unknown	USA	Vision loss	Steroids	Nearly complete blindness
(*16.*)	1981	10, M	Suspected *H. lineatum*	USA	Vision loss, scotomas	Vitrectomy, steroids	Unilateral blindness

(**17.**)	1981	11, M	*Cuterebra* sp.	USA	Eye pain, reduced vision	Vitrectomy, larva removal	Nearly complete blindness
(**15.**)	1980	13, M	*H. tarandi*	Norway	Vision loss, floaters	Vitrectomy, removal of larva	Mild vision loss
(**15.**)	1980	15, M	Unknown	USA	Vision loss	None	Mild vision loss
(**15.**)	1979	3 (sex unknown)	Unknown	USA	Asymptomatic	None	Complete recovery
(**15.**)	1979	49, M	Unknown	USA	Floater, vision loss	None	Major vision loss
(**15.**)	1974	21, M	Unknown	USA	Painful red eye	Steroids, thiabendazole, laser photocoagulation	Moderate vision loss
(**15.**)	1969	43, F	*Cuterebra* sp.	USA	Floater	None	Complete recovery
(**15.**)	1967	45, F	*Cuterebra* sp.	USA	Pain, red eye, vision loss.	Steroids, atropine	Mild vision loss
(**16.**)	1967	7, M	*H. lineatum*	USA	Red eye, vision loss	Vitrectomy, removal of larva, steroids	Unilateral blindness
(**17.**)	1945	12, M	Presumed *H. tarandi*	Norway	Red eye	None	Complete recovery
(**10.**)	1943	50, M	Presumed *H. tarandi*	Sweden	Painful red eye	None	Complete recovery
(**18.**)	1938	6, M	*Hypoderma* sp.	USA	Painful red eye	Pilocarpine, vitrectomy, larva removal	Not reported
(**19.**)	1934	46, M	Unknown	USA	Pain, red eye, vision loss	None	Complete recovery
(**20.**)	1933	48, M	Unknown	USA	Blindness, red eye	Atropine	Blindness

References

1. Gozum N, Kir N, Ovali T. Internal ophthalmomyiasis presenting as endophthalmitis associated with an intraocular foreign body. Ophthalmic Surg Lasers Imaging. 2003;34:472–4.
2. Buettner H. Ophthalmomyiasis interna. Arch Ophthalmol. 2002;120:1598–9.
3. Jakobs EM, Adelberg DA, Lewis JM, Trpis M, Green WR. Ophthalmomyiasis interna posterior. Report of a case with optic atrophy. Retina. 1997;17:310–4.
4. Glasgow BJ, Maggiano JM. Cuterebra ophthalmomyiasis. Am J Ophthalmol. 1995;119:512–4.
5. Phelan MJ, Johnson MW. Acute posterior ophthalmomyiasis interna treated with photocoagulation. Am J Ophthalmol. 1995;119:106–7.
6. Currier RW, Johnson WA, Rowley WA, Laudenbach CW. Internal ophthalmomyiasis and treatment by laser photocoagulation: a case report. Am J Trop Med Hyg. 1995;52:311–3.
7. Laborde RP, Kaufman HE, Beyer WB. Intracorneal ophthalmomyiasis. Case report. Arch Ophthalmol. 1988;106:880–1.
8. Gryseels B, Mertens DA, Mehl R. An imported case of ophthalmomyiasis interna posterior in The Netherlands caused by a larva of the reindeer warble fly. J Infect Dis. 1991;163:931–2.
9. Gjotterberg M, Ingemansson SO. Intraocular infestation by the reindeer warble fly larva: an unusual indication for acute vitrectomy. Br J Ophthalmol. 1988;72:420–3.
10. Syrdalen P, Stenkula S. Ophthalmomyiasis interna posterior. Graefes Arch Clin Exp Ophthalmol. 1987;225:103–6.
11. Rapoza PA, Michels RG, Semeraro RJ, Green WR. Vitrectomy for excision of intraocular larva (Hypoderma species). Retina. 1986;6:99–104.

12. Forman AR, Cruess AF, Benson WE. Ophthalmomyiasis treated by argon-laser photocoagulation. Retina. 1984;4:163–5.
13. Newman PE, Beaver PC, Kozarsky PE, Waring GO III. Fly larva adherent to corneal endothelium. Am J Ophthalmol. 1986;102:211–6.
14. Kearney MS, Nilssen AC, Lyslo A, Syrdalen P, Dannevig L. Ophthalmomyiasis caused by the reindeer warble fly larva. J Clin Pathol. 1991;44:276–84.
15. Syrdalen P, Nitter T, Mehl R. Ophthalmomyiasis interna posterior: report of case caused by the reindeer warble fly larva and review of previous reported cases. Br J Ophthalmol. 1982;66:589–93.
16. Edwards KM, Meredith TA, Hagler WS, Healy GR. Ophthalmomyiasis interna causing visual loss. Am J Ophthalmol. 1984;97:605–10.
17. Custis PH, Pakalnis VA, Klintworth GK, Anderson WB Jr, Machemer R. Posterior internal ophthalmomyiasis. Identification of a surgically removed Cuterebra larva by scanning electron microscopy. Ophthalmology. 1983;90:1583–90.
18. O'Brien CS, Allen JH. Ophthalmyiasis interna anterior, report of *Hypoderma* larva in anterior chamber. Am J Ophthalmol. 1939;22:996–8.
19. Anderson W. Ophthalmomyiasis interna. Case report and review of the literature. Trans Am Acad Ophthalmol Otolaryngol. 1934;39:218–39.
20. DeBoe M. Dipterous larva passing from the optic nerve into the vitreous chamber. Arch Ophthalmol. 1933;10:824.