The saprobiotic nematode *Pelodera strongyloides dermatitica* (Rhabditida: Rhabditidae) as a cause of dermatitis in Labrador retriever

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Summary. *Pelodera strongyloides* (Nematoda: Rhabditida) is a free-living saprobiotic nematode that inhabits dung and decaying organic matter. There are reports of skin invasions by the third-stage juveniles of *P. strongyloides* in dogs, some other mammals and even humans. A 6-year-old female Labrador Retriever showed signs of severe papulous dermatitis and alopecia on the front, lateral thorax and abdomen and on the outer sides of the thighs. The dog suffered from severe pruritus. Alive rhabditoid nematodes were found from skin scrapings. Juveniles were cultured on NGM agar and numerous free-living females and somewhat fewer male worms were obtained and identified as *Pelodera strongyloides dermatitica*. Juveniles of this particular strain, although aberrant invaders of dog's skin, show adaptations towards a parasitic mode of life. The biology of this subspecies and related species is discussed. The present case is the first documented finding of *P. strongyloides dermatitica* in Estonia.

Key words: *Pelodera strongyloides dermatitica*, dermatitis, domestic dog, Estonia, infective larvae.

In April 2003 a 6-year-old spayed female Labrador Retriever was brought to the Small Animal Clinic of the Estonian Agricultural University, Tartu, with signs of severe papulous dermatitis and alopecia on the front, lateral thorax and abdomen and on the outer sides of the thighs. Hairless skin was hyperpigmented, thickened and contained numerous papules. The dog suffered from severe pruritus. Appetite and general status were normal or even good. Skin scraping from a papule was taken and investigated under the microscope with 100x magnification. Several live moving worms with cylindrical slender bodies, 600-700 μm in length, were seen. All worms were of similar size and had rhabditoid pharynx. Parallel Dermatophyte (DTM) test was applied on hair samples that remained negative. A blood sample was taken and hematological and biochemical parameters were determined, as well as estimation of thyroid gland hormones (T4, TSH). All blood parameters were within normal ranges. The worms seemed to be the only cause of dermatitis. After 4 weeks of subcutaneous ivomec treatment, skin scrapings still contained live larvae. Finally, tea tree oil (New Directions Ltd., Australia) topical treatment of damaged skin was carried out for three weeks. During this therapy, pruritus disappeared gradually and hair started to grow, although a few live larvae were still found from skin scrapings. By the end of July all skin scrapings remained negative and the dog had totally recovered.

Cutaneous larval infections are relatively rare in dogs, especially in the temperate zone. In warmer climates, subtropics and tropics such nematode species as hookworm (*Ancylostoma caninum*), canine heartworm (*Dirofilaria immitis*), *Dipetalonema reconditum* and threadworm (*Strongyloides stercoralis*) may be evident (Georgi & Georgi, 1992). The dog described above had never been abroad to be able to collect any of these exotic parasites. *Strongyloides stercoralis* has not been registered in Estonian dogs yet. The only species found in Estonian dogs up to now that could, in its third developmental stage, infect skin is *Uncinaria stenocephala* but its juvenile stages have

no rhabditoid pharynx. To our knowledge the only possible explanation could be that the infection was with soil rhabditid nematodes. A well-known and ubiquitously distributed representative of this group is *Pelodera strongyloides* (Schneider, 1860), living as a saprophage in the manure of stables, especially of chicken-houses. Third-stage juveniles of a separate strain (Sudhaus & Schulte, 1988) may invade the skin of various domestic mammals, causing dermatitis.

MATERIAL AND METHODS

The worm material was collected from the above mentioned clinically ill Labrador Retriever in April 2003. Skin scrapings from papules containing rhabditoid juveniles were taken and the juveniles collected. The juveniles were washed in M9 medium and placed to the agar surface of Petri dishes. For larval cultures, NGM agar enriched with *E. coli* strain OP50 was used. Nematode media were prepared according to Sulston & Hodgkin (1988). Agar plates with worms were kept at room temperature.

Several re-seedings were performed. The morphology of females and males was studied by light microscopy, especially the buccal cavity, tail tip of females, bursa and spicules of males.

RESULTS

Culturing. Cultured juveniles developed into free-living adults and started rapid reproduction on agar plates. Egg laying females were already present the next day. During the following few days, worm cultures became overcrowded and worms were transferred to new agar plates. We were not able to find males from our first culture. The older cultures from new generations of worms contained males but they were fewer in number than females. One culture was kept alive without adding bacterial food for more than six weeks. At the end, only third-stage juveniles had survived.

Species identification. All developmental stages, including adult females (*ca* 1-2 mm long) and males (somewhat smaller), showed rhabditoid pharynx (Fig. 1). Males had typical peloderan bursa (Fig. 1), which was open, bearing 10 pairs of papillae. The arrangement of papillae was 1+1/5 + 3 (two pairs of precloacal papillae spaced + two groups of postcloacal papillae consisting of 5 and 3 pairs accordingly, nos. 3 and 10 open on the dorsal surface of the velum and no. 7 being the phasmid). Hence, the bursal formula was <v1, v2/(ad, v3, v4, v5, ph) (v6, v7, pd)> (v = ventral genital papillae, counted from anterior; ad = anterior, pd = posterior dorsal papilla; ph = phasmid; clustered papillae in brackets; see Sudhaus & Koch, 2004). Spicules were yellowish-brownish, straight and fused distally for two-thirds of their length. The tail tip of females was dome-shaped with a small not clearly set off spine with the length not exceeding 20 rm. The species was first identified as *Pelodera strongyloides* (Schneider, 1860) according to Bongers (1988). Hence, taking into account the physiological peculiarities of the worm, isolated by us, we assigned it as subspecies *dermatitica* (Sudhaus & Schulte, 1988).

DISCUSSION

About 40 case reports of 'rhabditic' dermatitis from different mammalian species have been recorded in Europe and North America during the last century (Sudhaus & Schulte, 1988). The earliest findings in dogs were reported in Germany in 1884 by Siedamgrotzky (reference cited in Sudhaus and Schulte, 1988). There are other reports of skin invasions due to *Pelodera strongyloides* in cattle, horses, sheep, guinea pig and red fox, but dog cases are the most numerous. The first human infection was described in Poland (Pasyk, 1978). One 11-year-old girl had pruritic lesions that lasted for 2.5 months. Juveniles were found in skin scrapings from the child and in the hair from the family dog. Up to now, four human cases have been documented in Europe, North America and Japan including also two adults (Ginsburg *et al.*, 1984; Jones *et al.*, 1991; Tanaka *et al.*, 2004).

Invasion of mammalian skin by *P. strongyloides* is often accompanied by erythema, extreme pruritus, alopecia, exfoliative dermatitis, and papules turning to pustules. The extreme pruritus is likely to lead to excoriations and secondary infection as a result of scratching. The ventral trunk and extremities are most severely affected as these parts come in direct contact with contaminated substratum and bedding materials. The direct skin contact with infested material is mandatory for *Pelodera* infection and the juveniles tend to remain near the point of invasion. Direct transmission among infected individuals does not occur. It is believed that the juveniles are not able to penetrate healthy skin and the infection subsides when the exposure to the juveniles ends (Georgi & Georgi, 1992), although no data exist about survival periods of juveniles in the skin.

Only third-stage juveniles of the dermatitic strain of *P. strongyloides dermatitica* are capable of invading the skin and hair follicles of dogs and other mammals listed above and development does not

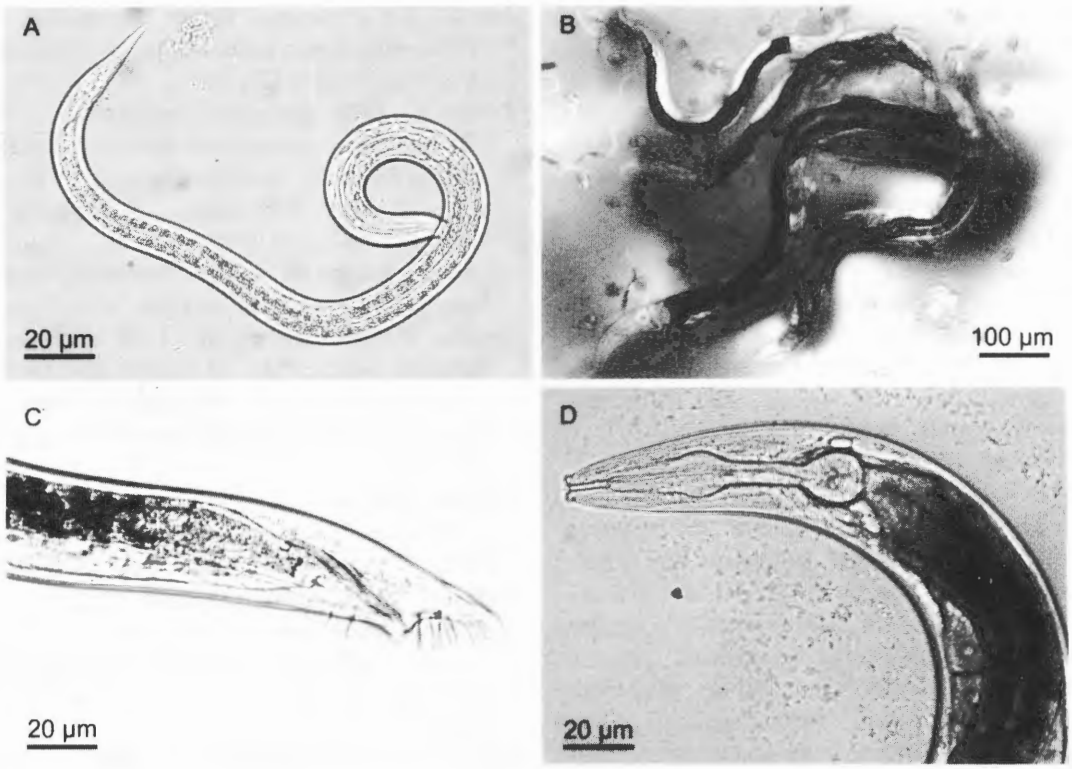

Fig. 1. Morphological features of *Pelodera strongyloides dermatitica*. A: Juvenile isolated from the skin of infected dog; B: Worm culture. Worms on NGM agar demonstrated rapid development and high fecundity; C: Posterior end of the male with typical peloderan bursa; D: Anterior end.

take place in mammalian skin (Sudhaus & Schulte, 1988). All other developmental stages are found in decaying organic material and that is where reproduction takes place. Juveniles obtained from skin scrapings grow and reproduce well on ordinary nutrient agar enriched with bacteria.

Decaying organic matter is the source of infection. Damp straw bedding often figures in the history of peloderan dermatitis. However, the abundant occurrence of *P. strongyloides* in the bedding does not guarantee infection (Georgi & Georgi, 1992).

The two subspecies *P. strongyloides dermatitica*, capable of causing dermatitis, and *P. strongyloides strongyloides*, inhabitant of dung and other decaying material, are morphologically similar and can be outcrossed in both directions. The most significant differences are found in the behaviour of the third-stage juvenile. As well as the normal third-stage in direct development, thedung strain' can give rise to dormant dauer-larvae, capable of surviving desiccation. In addition, the dermatitic strain can produce a third phenotype of third-stage juveniles, the infective juveniles (triphenism). These infective juveniles are unsheathed and tend to crawl out of the substrate (agar) after shaking. They climb to the edge of the Petri dish or to other dry places, show searching behaviour and migrate to the source of warmth if present. Such behaviour undoubtedly directs the worm to find a warm-blooded host (Sudhaus & Schulte, 1988). These two strains or ecological subspecies are not geographic. As *Pelodera cutanea* and *P. orbitalis* like *P. strongyloides dermatitica* exhibit larval triphenism with a thermotactic infective juvenile becoming a juvenile parasitic in mammals, it can be concluded that the totally free-living subspecies *strongyloides* is phylogenetically secondary. The natural (wild) host of the *dermatitica* strain is still unknown. All hosts listed above seem to be aberrant for *P. strongyloides dermatitica*, as it causes severe skin reactions and damage, which are not typical for other *Pelodera* infections in rodents.

Three closely related *Pelodera* species have adapted far more advantageously to the skin and eyes of rodents: *Pelodera cutanea* (Sudhaus, Schulte & Hominick, 1987), *P. merionis* (Sudhaus, 1991) and *P. orbitalis* (Sudhaus & Schulte, 1986). *Pelodera orbitalis* lives in the nests of rodents. Its

third-stage juveniles infect the orbits of rodents and live there parasitically in the lacrimal fluid of conjunctival sacs of the eyes. After about ten days they leave the rodent to complete the life cycle in the damp material of its nest. *Pelodera orbitalis* has been reported from the Northern hemisphere from the orbits of more than 20 species of *Muridae* and *Arvicolidae*, and its life cycle was studied in detail by Schulte (1989).

Pelodera cutanea was recorded in the skin of *Apodemus* mice and *Pelodera merionis* in the skin of *Meriones tamariscinus*. Sudhaus *et al.* (1987) suppose that the juveniles leave the host in its nest, propagate there as bacterial feeders, and form new infective juveniles that invade mice.

As mentioned above, triphenism of the third-stage juvenile has been observed in *P. cutanea* and *P. orbitalis*. The resistant dauer-larvae and infective juveniles do arise from one common pre-stage. After metamorphosis has taken place, the dauer-larva cannot transform to the infective juveniles and *vice versa*. Only dauer-larva will resume development independent from mice on fresh medium (e.g. agar plates with bacteria). The infective juveniles require a living mouse host prior to completion of its life cycle. Thus, the infective juvenile stage is obligatory: it helps in the dispersal to new nests and it must obtain nourishment from the host to develop further.

The unusual associations of *Pelodera* with mammals demonstrate the great ecological potency of Rhabditidae and might serve as models to examine the first steps towards parasitism in nematodes.

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Talvik H., Sudhaus W., Moks E., Liivla G., Krall E. Сапробиотическая нематода Pelodera strongyloides dermatitica – причина дерматита у домашней собаки породы лабрадор.

Резюме. *Pelodera strongyloides* (Nematoda: Rhabditida) – это свободноживущая нематода, обычно встречающаяся в навозе или другом разлагающемся органическом материале. Имеются сообщения о поражениях личинками третьей стадии этих нематод кожных покровов собак, некоторых других млекопитающих и даже человека. У шестилетней суки породы лабрадор был выявлен тяжелый папуллозный дерматит и алопеция передней и боковых частей груди, брюха, а также наружных поверхностей бедер. Собака также страдала от сильного зуда. В соскобах кожи были обнаружены живые рабдитоидные личинки. Личинок культивировали на NGM-агаре, что позволило получить многочисленных самок и несколько меньшее количество самцов. Взрослые нематоды были определены как *Pelodera strongyloides dermatitica*. Хотя личинки этого вида являются лишь казуистическими обитателями кожных покровов собак, они показывают определенные адаптации к паразитическому образу жизни. Обсуждается биология данного подвида нематод и родственных форм. Данный случай представляет собой первое документированное обнаружение *P. strongyloides dermatitica* в Эстонии.