Pathology of the nematode *Trichosomoides crassicauda* in the urinary bladder of laboratory rats

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Summary
The worms caused mild epithelial damage and were lying upon, or partially embedded in the epithelium and submucosa of the urinary bladder, and occasionally in the lower part of the medullary collecting tubules or in the urinary pelvic cavity, with associated papillitis and pyelonephritis. The incidence of urinary nematodiadisis in these young caesarian-derived but conventionally-bred rats was high (66%).

*Trichosomoides crassicauda*, a nematode of the urinary bladder of rats (Bellingham, 1840), occurs in the wall of the bladder and occasionally in the upper ureter and within the renal pelvis of wild and laboratory rats (Weisbroth & Scher, 1971). It has been reported in conventional rat colonies (Bone & Harr, 1967), but does not appear to occur in caesarian-derived, barrier-maintained colonies (Bell, 1968).

This relatively nonpathogenic, hair-like worm has been associated with blood eosinophilia (Ahlqvist, Rytömä & Borgmastals, 1963), and with the formation of urinary calculi and bladder tumours (Chapman, 1964; Smith, 1946). It is also known to evoke the presence of globule leucocytes in the transitional epithelium of infested urinary tracts (Ahlqvist & Kohonen, 1959). A serological response has been detected as a consequence of infection (Smith, 1946), but overt manifestations of parasitism are only observed in experimental infections and consist of pulmonary damage during larval migration (von Fricsay, 1956).

It has been reported as endemic among wild rats in Finland (Ahlqvist & Kohonen, 1962), but relatively little has been published on the incidence of this infestation in commercial colonies of laboratory rats. The parasite was found in 67 of 320 surviving laboratory rats (Bone & Harr, 1967), where is was more common in males and showed a definite correlation between age and parasitism in that all but 3 of the parasitized rats were over 720 days old.

Materials and methods
200 caesarian-derived Wistar rats, equal numbers of male and female, were obtained from a commercial breeder in Belgium at 1-2 months of age and then kept conventionally for use in a short-term (13 weeks) toxicity study. They were housed in groups of 5 per cage in galvanized-steel cages with mesh floors. There was free access to food and water. The air temperature of the animal room was 22 ± 1°C and the relative humidity 45-55%. The light-dark cycle was 12:12 h.

At the end of the study the rats were killed with carbon dioxide, and at necropsy specimens were taken of all major organs, including the urinary bladder, fixed in 10% formol saline, embedded in paraffin wax, sectioned at 5-6 μm, and stained with haematoxylin and eosin.

Results
132 of the 200 rats examined (66%) showed infestation by *Trichosomoides crassicauda* in the urinary bladder. Almost equal numbers of male (72/132) and female (60/132) rats were infested, and there was no significant difference in incidence between control and treated groups. Microscopically, the main feature of the infested bladders was the presence of sections of nematode parasites, frequently with their bicornuate uteri filled with eggs and embryonated larvae. They were lying upon, or partially embedded, in the epithelium and submucosa. Thick-walled, golden, double-operculated ova were seen in the lumen of infested bladders (Figs 1 and 2).

The majority of the cases did not show obvious pathological changes in the bladder wall. However, in some, or where the parasites and their eggs were most intimately in contact with the wall, there was a slight hyperplastic response with erosion of the epithelium (Fig. 3). Occasionally there was slight chronic inflammatory-cell infiltration, mainly of lymphocytes and plasma cells but with few eosinophils, of the submucosa of the bladder or the renal peripelvic region. Globular leucocytes were also seen in infested urinary tracts.

A heavily-infested female rat, killed at 102 days old because of weight loss and bad condition, showed 80% polymorphonuclear leucocytes in the blood, and large lung abscesses were reported at necropsy. Microscopic examination revealed numerous parasites in the...
Fig. 1. Sections of gravid female worms in the epithelial wall and lumen of the urinary bladder of a rat. Haematoxylin and eosin. Line represents 16 μm.

Fig. 2. Sections of gravid female nematodes in the wall of the urinary bladder. Note female worm burrows into the bladder mucosa, leaving her posterior end extending into the lumen. Haematoxylin and eosin. Line represents 16 μm.

Fig. 3. Moderate thickening of epithelial lining with associated subepithelial minimal inflammatory cells. These changes are in association with a section of an adult parasite. Haematoxylin and eosin. Line represents 6 μm.

Fig. 4. Lung of infested rat. Granulomatous lesion. Could be due to migrating larvae of *T. crassicauda*. Haematoxylin and eosin. Line represents 10 μm.
Fig. 5. Section of juvenile worm (migratory stage) in the pelvic cavity of the kidney. Haematoxylin and eosin. Line represents 16 μm.

Fig. 6. Sections of larvae inside the transitional pelvic epithelium of kidney. Haematoxylin and eosin. Line represents 6.3 μm.

Fig. 7. Focal area of papillitis and dilating medullary collecting tubules in association with section of larva. Haematoxylin and eosin. Line represents 10 μm.

Fig. 8. Sections of worms embedded in the transitional epithelium of the urinary pelvis, with a papillitis. Haematoxylin and eosin. Line represents 10 μm.
wall of the urinary bladder, with areas of severe submucosal fibrosis with associated small foci of mixed inflammatory cells. Microscopic examination of the lungs revealed areas of granulomatous reaction associated with central necrosis containing remnants of parasitic larvae (Fig. 4).

Migratory-stage larvae and immature worms were seen in the transitional epithelium of the renal pelvis (Fig. 5) or in the intra-epithelial location of the renal pelvic epithelium (Fig. 6) in 6 rats. In 2 of these the larvae or immature worms were seen in the medullary collecting tubules (Fig. 7) with associated focal papillary necrosis and pyelonephritis (Fig. 8). No other significant microscopic pathological findings were noted.

Discussion
Infestation with *T. crassicauda* is usually without significant clinical signs, although persistent eosinophilic infiltration may occur (Shadduck & Pakes, 1978). Urinary calculi and bladder tumours have been associated with infestation with this parasite, but a definite causal relationship has not been established (Chapman, 1964; Smith, 1946). Neither urinary calculi nor tumours of the urinary bladder were detected in any of the rats examined in this study.

The microscopical observation of this nematode in the renal pelvis and bladder, with its eggs in the lumen, accords with previous reports (Bone & Harr, 1967; Chapman, 1964). The eggs are passed in the urine of infested animals, whose offspring become infested prior to weaning (Mullink, 1979). Eggs are not usually present in the urine of rats infested as neonates until 8-12 weeks of age (Flynn, 1973). Thus our findings of infested rats as young as 14-15 weeks suggest that they were infested as neonates or at any rate prior to weaning.

Vertical transmission of the infestation (from parent to offspring within the same cage) was conclusively shown by Weisbroth & Scher (1971), who reported a high incidence of infestation but denied that in-utero transmission occurred.

The results of this present study, however, do not accord with those of Bone & Harr (1967), who found a definite relationship between age and sex and the infestation of their rats. No similar pyelonephritic changes have previously been reported.

References


Pathologie des Nematoden *Trichosomoides crassicauda* in der Harnblas von Versuchs ratten

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Zusammenfassung
Die Würmer verursachten geringe Epithelschäden und lagen teilweise auf dem oder eingebettet im Epithel und der Submukosa der Harnblase. Gelegentlich waren sie im unteren Teil der Marksammelanälchen oder im Nierenbecken mit Papillitis und Pyelonephritis vergesellschaftet. Die Häufigkeit der Harnwegsnematositis bei diesen jungen, kaiserschnittgewonnenen aber konventionell aufgezogenen Ratten war hoch (66%).