

Transcutaneous Infection by Gnathostoma spinigerum

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OBJECTIVE: To characterize experimental gnathostomiasis induced by the recently discovered transcutaneous route.

DESCRIPTION: Three cats, three dogs, one adult civet cat (Viverricula indica) and one palm civet cat (Paradoxulus hermaphroditus canus) were exposed to transcutaneous infection through the shaved, intact abdominal skin with G. spinigerum advanced third-stage larvae removed from experimentally infected white mice. Stools were examined weekly after infection for the presence of gnathostome ova. Autopsies were performed on the animals after a specified time to examine for the development and migration of the worms in various organs.

PROGRESS: The results of observations on the 3 cats, 3 dogs, 1 civet cat and 1 palm civet cat were as follows:

On autopsy, cats number 83 and 91 showed no infection with the parasite. The remaining cat (# 84) was kept for further infection with G. spinigerum larvae.

On autopsy, dogs number 2 and 10 showed no gnathostome infection. The remaining dog (# 18) died of an unknown cause on day 66 during the patent period. On necropsy, 3 small gastric tumors at the greater curvature of the stomach yielded 45 (70% worm recovery rate) living mature adult males and females.

In Tables 1 and 2, a summary of the experimental study on transcutaneous infection by G. spinigerum advanced third-stage larvae through the healthy intact skin of 19 common definitive hosts of the worm (10 cats and 9 dogs) shows that the successful rate of skin penetration of the larvae varied from 39–100% with not more than 2-hour exposure. The prepatent period of the parasite was found to be 60–310 days in cats, thus the life cycle of the worm in cats could be completed in 2–10 months. The prepatent period in dogs was 96–247 days, or the time required to complete the life cycle about 3–8 months. It was also found that the larvae, after completing the penetration through the skin of the animals, were found infecting many organs. Sometimes mature adults were found in the stomach wall; concurrently, the larvae and or immature worms were found in other organs of the host. This finding seems to indicate that the larvae do not develop at the same rate in the host after completing the transcutaneous phase.

The civet cat was never found to pass ova and on necropsy showed 15 living larvae (14 unencysted and 1 encysted larvae) located in the muscles of the abdominal wall, back, and fore- and hind-legs. One mature adult male was located in the right costal muscles. The 11 larvae were only slightly larger than before the experiment. The palm civet cat never became ova positive and at necropsy there were 11 living larvae (6 encysted and 5 unencysted) in the abdominal muscles. The results indicate that the civet cat could potentially act as a natural definitive host because the site near the stomach wall was found infected with 1 mature adult male. The palm civet cat may perhaps be considered as the paratenic host because only the larvae could be found infecting the animal.

Table 1. Skin penetration by *Gnathostoma spinigerum* advanced third-stage larvae in 10 adult domestic cats up to end of reporting year 1971.

Animal No.	Source of larvae	No. of larvae penetrated thru the skin and %	Days from skin penetration of larvae to first ova positive stool (prepatent period)	Days from first ova positive stool to first ova negative (patent period)	Autopsy findings			Remarks
					No. of worms recovered and %	Stages of worms recovered	Organs infected by worms	
Cat 38	white mice & snake-headed fish	53 (62 %)	154 +	-	27 (51 %) males, females and larvae	immature adult and larvae	stomach abdominal wall chest wall omentum diaphragm	Sacrificed on 14 Jan 69 (day 154 of prepatent period)
Cat 73	white mice dog	42 (93 %)	176	144 +	3 males (7.0%)	mature adult	gastric tumor and omentum	Died of unknown causes with ova positive stool (day 144, on 22 July 69)
Cat 74	snake-headed fish	46 (90 %)	195 +	-	26 males, females and larvae (56%)	immature adult and larvae	stomach diaphragm, costal, abdominal and back muscles, abdominal fat	Died perhaps of vaccination (on 1 April 69, day 195 of prepatent period)
Cat 77	white mice	85 (100 %)	227	28 +	46 mature and immature and larvae (54%)	mature and immature adults and 1 larva	stomach diaphragm peritoneum muscles of abdomen and chest	Died during ova positive stools (day 28 of patent period, on 11 July 69)
Cat 83	white mice	61 (100 %)	310	89	-	-	-	Sacrificed 385 days after the last positive stool. Autopsy negative
Cat 84	white mice	44 (66.7%)	127	100	-	-	-	Ova negative stool 537 days after the last positive up to end of reporting year. Kept for further infection
Cat 87	white mice	18 (100 %)	22 +	-	17 larvae (94.4%)	larvae	liver, skin, diaphragm abdominal fat	Died perhaps of vaccination on 1 April 69 (day 22 of prepatent period)
Cat 89	white mice	45 (75%)	22 +	-	38 larvae (84.4%)	larvae	liver abdominal muscle abdominal fat	Died perhaps of vaccination on 1 April 69 (day 22 of prepatent period)
Cat 91	white mice	59 (93%)	60 +	357	-	-	-	Sacrificed 107 days after last positive stool. Autopsy negative.
Cat 97		10 (100 %)	60 +	-	7 larvae (70%)	larvae	liver	Died on 6 Oct 69 (day 60 of prepatent period)

Table 2. Skin penetration by *Gnathostoma spinigerum* advanced third-stage larvae in 9 adult domestic dogs up to end of reporting year 1971.

Animal No.	Source of larvae	No. of larvae penetrated thru the skin and %	Days from skin penetration of larvae to first ova positive stool (prepatent period)	Days from first ova positive stool to first ova negative (patent period)	Autopsy findings			Remarks
					No. of worms recovered and %	Stages of worms recovered	Organs infected by worms	
Dog 1	white mice	65 (79.3%)	231	31 +	41 mature males & females (63 %)	mature adult	stomach lung omentum	Sacrificed on 3 July 69 with ova positive stools (day 31 of patent period)
Dog 2	snake & snake-headed fish	76 (100%)	247 (from first skin infection)	257	-	-	-	Sacrificed 143 days after the last positive stools. Autopsy negative
Dog 9	white mice	192 (81.4%)	222 (from first skin infection)	58	9 larvae (4.7%)	larvae	hind leg muscle costal muscle abdominal muscle, abdominal fat	Sacrificed with ova negative stools, 26 Sept 69 (57 days after last positive stool)
Dog 10	white mice & snake	119 (69.6%)	234 (from first skin infection)	228	-	-	-	Sacrificed 144 days after the last positive stools. Autopsy negative
Dog 11	white mice	33 (97.1%)	1 +	-	28 larvae (85.0%)	larvae	skin abdominal flesh	Died on 5 Sept 68 with ova negative stool (day 1 of prepatent period)
Dog 12	white mice	88 (96.7%)	498 +	-	2 larvae (2.3 %)	larvae	dorsal muscle fore-leg muscle	Sacrificed on 26 Feb 70 with ova negative stool (day 498 of prepatent period)
Dog 13	white mice	64 (38.6%)	112 (from first skin infection)	329 +	-	-	-	Discharged on 17 Oct 69 from the study for being uncontrollable
Dog 14	white mice	68 (46.2%)	96 (from first skin infection)	253 +	33 immature females, mature males & mature females (48.5%)	immature females, mature males mature females	stomach diaphragm esophageal wall	Sacrificed on 23 July 69 during ova positive stools (day 253 of patent period)
Dog 18	white mice	64 (100%)	231	66 +	45 (70%)	Mature adult males & females	Stomach	Died of unknown cause day 66 of patent period

SUMMARY: Continued observations of transcutaneous infection with G. spinigerum advanced third-stage larvae on 3 cats, 3 dogs, 1 civet cat and 1 palm civet cat showed that the cats had prepatent periods ranging from 60 to 310 days and patent period of 89-357 days. In 3 dogs the prepatent periods ranged from 231 to 247 days and the patent periods from over 66 to 257 days. The larvae, after completing the skin penetration, were found developing to immature adults at different rates before becoming mature adults in the stomach wall. The civet cat was considered to be a potential definitive host, but the palm civet cat was thought to be a paratenic host (transmitting host).

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