

times more likely to be malignant than those without a mass present. In light of this information, a surgeon is obligated to proceed with biopsy when serial screening mammography for increase in size and density of a lesion can result in misdiagnosis and progression of an otherwise easily treated carcinoma to a higher stage that may require more aggressive therapy. Intervention by surgical biopsy with needle localization of microcalcification with associated masses is essential. Many times, lumpectomy with frozen section examination to determine disease-free margins may be all that is necessary in treatment of noninvasive early breast carcinoma.

Comment

A retrospective study of 192 needle-localized breast biopsies done to evaluate non-palpable mammographically detected lesions revealed that the roentgenographic finding of microcalcification present with a dominant mass is more likely to be malignant. Aggressive treatment of such lesions is recommended. Biopsy should be undertaken without delay to improve cancer detection, early treatment, and survival rate.

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Brief reports

Eustrongylidiasis—A parasitic infection acquired by eating live minnows

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The objective of this study was to heighten physician awareness of eustrongylidiasis by investigating the epidemiology of this parasitic infection. The nematode *Eustrongylides ignotus* was recovered surgically from our patient, in whom eustrongylidiasis simulated acute appendicitis. The patient had consumed two live minnows obtained from Big Timber Creek of Belmawr, NJ. The authors determined the *E ignotus* infestation rate of free-living minnows at this creek. With this data, they approximate the probability of human infection with *E ignotus* after eating live minnows and attempt to evaluate the hypothesis that eating live minnows may lead to eustrongylidiasis.

(Key words: Eustrongylidiasis, *Eustrongylides ignotus*, acute appendicitis, piscivory, limnadrilus, minnows)

The consumption of live minnows may cause eustrongylidiasis. A 17-year-old white male patient consumed two live minnows obtained from Big Timber Creek of Belmawr, NJ. Approximately 3 days later, he had right lower quadrant pain and underwent an exploratory laparotomy for suspected acute appendicitis. On surgical exploration of the peritoneal cavity, two large (0.08 m), reddish pink *Eustrongylides ignotus* nematodes were removed from the region of the appendix. Infection had resulted from the consumption of the live minnows. We ascertained the minnows' habitat and studied the infestation rate of eustrongylidiasis among this selected group of free-living minnows. Through these data, we determined the

probability of eustrongylidiasis resulting after consumption of live minnows from this selected population.

Report of case

A 17-year-old boy had a history and findings on physical examination characteristic of acute appendicitis. He complained of right lower quadrant pain that worsened with movement, improved when he was in a bent-over position, and radiated to the right flank. The corresponding physical findings included right lower quadrant tenderness, voluntary guarding, and a temperature of 38°C. The initial laboratory studies revealed a leukocyte count of $13.6 \times 10^3/L$, with 72% polymorphonuclear leukocytes, 21% lymphocytes, and 7% monocytes. No eosinophils were present on the peripheral blood smear. Results of all other laboratory studies were within normal limits. An abdominal x-ray film series showed no obstruction.

The patient underwent emergency exploratory laparotomy that revealed a normal-appearing appendix. The cecum was found to be mildly erythematous, and two approximately 0.08-m reddish

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worms were discovered in the right lower quadrant of the peritoneal cavity. Histopathologic examination confirmed a normal appendix. The worm specimens were identified as belonging to the *Eustrongylides* genus and further clarified as consistent with the *ignotus* species. The patient had an uncomplicated postoperative course, and he was discharged 3 days postoperatively.

Further discussion with the patient revealed an unusual dietary history. The patient admitted to ingesting two live minnows 3 days before seeking medical attention. He caught the minnows in a local creek and swallowed them live in response to a dare.

Methods

Minnows were collected by use of a cylindrical wire minnow trap baited with bread. At high tide, we examined the trap at 20-minute intervals and collected all specimens. Thirty-eight minnows were collected and preserved in a 5% formaldehyde solution. Dissection (Figures 1 and 2) revealed that 5 (13%) of the 38 minnows were infested with *Eustrongylides* species, 2 (40%) of the 5 had two nematodes each. A second collection was done to estimate the size of the selected minnow study group. Forty-two minnows were collected, tagged, and returned to the creek. The next day, we collected 245 minnows; 22 of this collection had the tag. From this information, we estimated the size of the selected minnow study group at approximately 460. Additionally, *Eustrongylides* specimens were sent to the Centers for Disease Control and Prevention (CDC) for species identification. The *Eustrongylides* species obtained from our patient was compared with the nematodes from the infested minnows; all specimens were *E. ignotus*.

Results

A total of 38 minnows were dissected; 33 were free of infestation with nematodes (*Eustrongylides*). Five minnows (13%) were infested with nematodes. In each of the five infested minnows, the nematode *E. ignotus* was identified. Among the five infested minnows, three minnows (60%) had one nematode, and

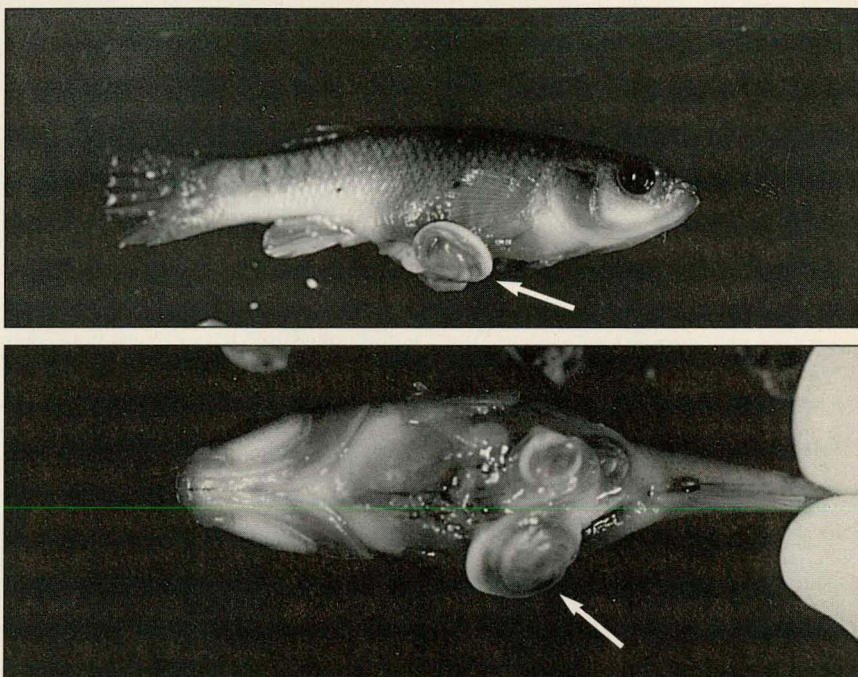


Figure 1. Minnow after ventral dissection. Arrows indicate parasite in protective sac.

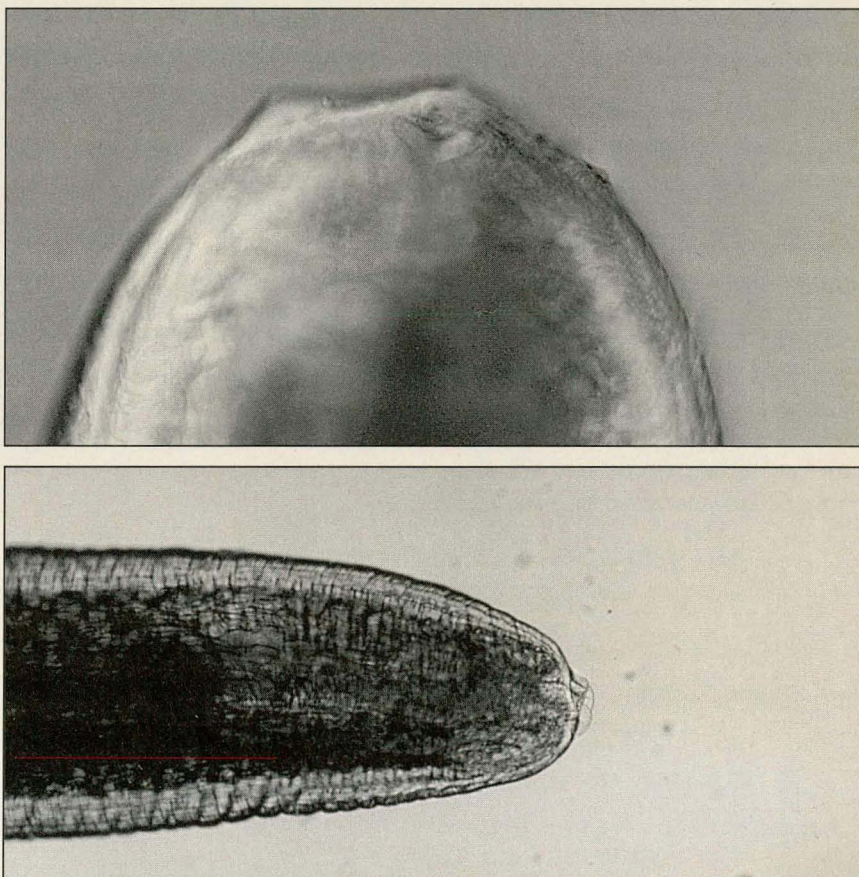


Figure 2. Nematode (*Eustrongylides ignotus*) under magnification; cephalic end at top, caudal end at bottom.

two minnows (40%) had two nematodes. We determined the probability of a minnow's noninfestation, infestation with one nematode, and infestation with two nematodes to be .8684, .0790, and .0526, respectively. Thus, with the ingestion of a single minnow, it is more likely that one would ingest a noninfested minnow than an infested minnow. It is least likely that one would ingest a single minnow with two nematodes. Our patient consumed two minnows and became infected with two nematodes. To determine the most probable mode of acquiring two nematodes, we calculated the probability that each ingested minnow contained one nematode ($P1$) to be .0062. The probability that one ingested minnow was free of nematodes and one ingested minnow contained two nematodes ($P2$) was 0.0914. It is most probable that the patient ingested both a noninfested minnow and an infested minnow harboring two nematodes; 14.7 times more likely than ingesting two minnows each infested with one nematode ($P1 + P2$).

Discussion

Eustrongylides species were described by Jägerskiöld in 1909, and are classified into three distinct species: *Eustrongylides tubifex*, *Eustrongylides ignotus*, and *Eustrongylides excisus*.¹ The species *E. ignotus* was identified in both our patient and the minnow study group. The elucidation of the life cycle of *Eustrongylides* species was made by Measures.² Basically, *Eustrongylides* eggs from an infested *Mergus merganser* (red-breasted bird), after incubation, evolve into first-stage larvae. When the larvae are exposed to

limnodrilus (aquatic oligochaetes such as earthworms or marine worms), further evolution to second- and third-stage larvae occurs. Fish may act as second intermediate hosts through exposure to the aquatic oligochaetes. Additionally, fish may act as hosts through piscivory² (fish eating).

Eustrongylidiasis attains clinical significance when the ingestion of improperly cooked, infected fish leads to infection with the nematode.³ *Eustrongylides* infection may simulate acute appendicitis and require surgical exploration for removal of the parasites.⁴ At present, no effective chemotherapeutic agent exists for eustrongylidiasis. In the evaluation of abdominal pain, clinicians may gain valuable information from a thorough dietary history. This discussion should include inquiry about the ingestion of improperly cooked or raw fish.^{5,6} Eustrongylidiasis should be included in the differential diagnosis of abdominal pain.

Comment

We conclude that the ingestion of free-living minnows may cause eustrongylidiasis, the presentation of which commonly simulates that of acute appendicitis. Treatment of this condition requires surgical removal of the nematode. The potential for contracting this infection from eating minnows is fairly great. As such, we recommend a thorough dietary history and the addition of eustrongylidiasis to the differential diagnosis of abdominal pain

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