A case report on the gallbladder fluke, *Euparadistomum herpestesi* (Trematoda: Dicrocoeliidae), in stray cats (*Felis catus*) in Beni-Suef, Egypt

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Abstract Scarce literature studying parasites, particularly helminths, of gallbladder of cats in Egypt are available. Stray cats (*Felis catus*) are widespread in Beni-Suef, Egypt. Therefore, a total of 62 stray cats were necropsied and parasitologically examined. Three (4.84%) cats harboured an ovoid yellowish to brown flukes in the gallbladder. Infected cats were females and aged more than 3 years. The worm burden ranged 1–3 (one cat harboured 3 flukes and the other 2 cats were infected by one fluke each). Moreover, Mixed infections with intestinal cestodes and/or nematodes were detected. The fluke is quite discoid measuring 7.75×3.25 mm. The oral sucker measured 1 mm in diameter. The acetabulum was nearly central, rounded and measured 0.75 mm in diameter. Short pharynx (no prepharynx). Two broad intestinal ceca extending short distance from the posterior extremity of the fluke. Testes are ovoid, opposite to each other occupying the anterior half, each measured 0.25 mm in diameter. The ratio of testes to the acetabulum is characteristically 1:2. Ovary was somewhat ovoid, measured 0.3×0.45 mm, and attached to it a large dorsal chamber of receptaculum seminis measuring 0.58×0.52 mm. Vitellaria extended from the level of testes along the length of intestinal caeca or somewhat shorter than length of them. Uterus consisted of several coils occupying the entire area behind the oral sucker. Based on those criteria, the recovered flukes might be identified as *Euparadistomum herpestesi*. To the best of

authors' knowledge and based on the microscopic identification, it is the first preliminary report denoting the existence of the gallbladder flukes, *E. herpestesi*, from stray cats in Beni-Suef, Egypt.

Keywords *Euparadistomum herpestesi* · Stray cats · Gallbladder · Egypt

Introduction

Stray cats, *F. catus*, is known to be as a common predator in the wild natural ecosystem worldwide and they are highly potential predator actively consume wide-ranged food stuffs including mammals, rep-tiles, aves, amphibians, and other invertebrates (Chai et al. 2013; Hajipour et al. 2016). Stray cat populations act as potential reservoir hosts of a variety of parasites posing both veterinary and medical importance (Arafa et al. 1978). Such cats absolutely accommodate to both urban and rural areas and tend to discharge their parasitic infective stages into the surrounding environment (Shahram et al. 2002; Bahadori et al. 2004; Sharif et al. 2007; Zibaei et al. 2007; Arbabi and Hooshyar 2009). They act as definitive hosts and carriers for several helminths, some of which are of zoonotic potential and have been assumed as life-threatening problems (Kazacos 2002; Mircean et al. 2010).

In the tropical and subtropical areas, gastrointestinal parasites are a common source of diseases for cats; those parasites may induce great public health hazard in both Egypt and worldwide. The parasitic burden in stray cats is influenced by several factors; availability of intermediate hosts, geographical distribution, habits of the animal populations and seasons (Mircean et al. 2010).

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Previous studies in Egypt and worldwide revealed that stray/feral cats are known to be frequently parasitized, particularly with helminths, and those cats harboured several species of digenean trematodes, often of zoonotic importance, in the small intestine; Heterophyidae, Diplostomidae, Cyathocotylidae, Echinostomatidae and Plagiorchiidae (Huh et al. 1993; Sohn and Chai 2005; Adams et al. 2008; Shin et al. 2009; Khalafalla 2011; Thabit 2011; Chai et al. 2013; El-Azazy et al. 2016; El-Dakhly et al. 2017).

Other organs, rather than the small intestine, such as livers and gall bladders may be parasitized by dicrocoeliid flukes, as *Euparadistomum* species and *Platynosomum* species. Those flukes are found in tropical and subtropical districts with more or less pathogenic effects on their hosts (Ferreira et al. 1999; Xavier et al. 2007). In the gall bladder, the dicrocoeliid genus *Euparadistomum* is fairly common (Ravikumar et al. 1979). Several decades ago, a domestic cat is considered a new host for *Euparadistomum* spp. (Buckley and Sheng-Liang 1958). Later, *Euparadistomum* sp. is recovered from the gall bladder of cats in Port Moresby, New Guinea (Talbot 1969), *Euparadistomum pearsoni* from the gallbladder of domestic cats in Papua, New Guinea (Talbot 1970), *Euparadistomum cercopithecii* from monkey in Equatorial Guinea (Fischthal 1969), and *Euparadistomum lophuromidis* from rodents in Ivory Coast (Baer 1971). So far, the life cycle of *Euparadistomum* spp. is still under investigation, although terrestrial arthropods and lizards may act as intermediate hosts (Kok et al. 1992).

In Egypt, no literature on either the morphology or the biology of *Euparadistomum* spp. is available. Therefore, the present study aimed to identify and record the occurrence of the gallbladder fluke, *E. herpestesi* (family: Dicrocoeliidae) in gall bladder of stray cats (*F. catus*) in Beni-Suef province, Egypt for the first time.

Materials and methods

Sixty-two stray cats, *F. catus*, (36 males and 26 females and most of them aged more than 3 years) were captured and necropsied from different localities in Beni-Suef province (coordinates: 29°04'N 31°05'E), Egypt during the period from May 2015 to November 2016. Stray cats are sent immediately to the laboratory of Parasitology, Faculty of Veterinary Medicine, Beni-Suef, Egypt for necropsy. Gross examination of cats revealed no visible abnormalities. A complete necropsy of cats was performed, during which, the abdominal cavity was opened and the internal organs including stomach, intestines, liver, heart, urinary bladder and lungs were thoroughly examined by naked eyes. Liver, bile ducts and gall bladder were carefully examined for the detection of helminths, particularly

trematodes. All parts of the alimentary canal were examined for helminthosis (El-Dakhly et al. 2017). Contents of each portion were separated in clean Petri dishes and examined under a dissecting microscope. Available images are photographed using a digital microscope (Leica microsystems, CH-9435 Heeburg, Ec3, Singapore). Measurements of the recovered adult trematodes were in millimeters. Identification of the recovered digeneans was done according to the description of Ravikumar et al. (1979). The recovered trematodes were gently compressed between two slides and were then fixed in 10% neutral buffered formalin, washed with distilled water, and stained with potassium alum carmine (for up to 4 h). They were dehydrated in ascending grades of ethyl alcohol (70, 80, 90, 95, and 100%), cleared in xylene, and mounted with Canada balsam (El-Dakhly et al. 2012, 2018).

Description and biology of the fluke

Out of 62 examined stray cats, 4.84% (3/62) harboured an ovoid yellowish to brown digeneans habit in the gallbladder (Fig. 1). Infected cats were females and aged more than 3 years. The worm burden was low; one cat harboured 3 specimens and the other 2 cats were infected by one digenean each. Moreover, one cat was co-infected with other intestinal helminths; cestodes (*Diplopylidium nolleri* and *Joyeuxiella pasqualei*) and nematodes (*Toxascaris leonina*). The other 2 cats were co-infected with the intestinal cestodes, *Dipylidium caninum* and *J. pasqualei*, one for each.

Based on recovered 5 mature specimens, flukes are quite discoid and flattened measuring 7.75×3.25 mm (larger than other *Euparadistomum* species). The oral sucker was

Fig. 1 Adult *E. herpestesi* recovered from the gallbladder of parasitized stray cats. Note the characteristic discoid shape of the flukes

rounded, anteriorly located and measured 1 mm in diameter. The acetabulum was central, rounded and measured 0.75 mm in diameter. Mouth opening leads to short pharynx (no prepharynx) that continuous into narrow oesophagus measured 0.5 mm in length and opens into two broad intestinal caeca which extend short distance from the posterior extremity of the fluke. Testes are ovoid, opposite to each other occupying the anterior half, each measured 0.25 mm in diameter. The ratio of testes to the acetabulum is characteristically 1:2. Ovary was somewhat ovoid, measured 0.3×0.45 mm and attached to it a characteristic large dorsal chamber of receptaculum seminis measuring 0.58×0.52 mm. Vitellaria extended from the level of testes along the length of intestinal caeca or somewhat shorter than length of them. Uterus consisted of several coils occupying the entire area behind the oral sucker (Fig. 2). Based on those criteria, the recovered fluke might be identified as *E. herpestesi*.

To the best of authors' knowledge, based on the microscopic identification, it is the first preliminary report denoting the existence of the gallbladder fluke, *E. herpestesi*, from stray cats, *F. catus*, in Beni-Suef, Egypt.

In the present study, *E. herpestesi* is recovered from the gall bladder of three infected cats with a prevalence of 4.8%. According to the key describing *Euparadistomum* Tubanguí (1931) species, *E. herpestesi* resembles *E. upupai* (Chatterji 1952), both flukes have the diameter of testes is approximately half that of the acetabulum and the genital pore is located ventral to the caecal bifurcation. The discrepancy is in the shape of the ovary; in *E. upupai* it is

lobed while in *E. herpestesi* is somewhat elongated along the entire walls (Talbot 1970). Furthermore, the ovary is slightly overlapped by the acetabulum but in *E. upupai* is not overlapped by the acetabulum. On the other hand, the fluke in the present work was relatively larger than *E. upupai* measuring 7.75×3.25 mm and the ratio between the testes and the acetabulum was 1:2. Moreover, the current *E. herpestesi* had a characteristic feature; the dorsal chamber of receptaculum seminis was obvious and is a unique feature for *E. herpestesi*. Such finding absolutely concomitant with that obtained by Ravikumar et al. (1979) who recorded similar results from mongoose in Visakhapatnam district.

So far, the life cycle of *Euparadistomum* spp. is not known with being arthropods may act as intermediate host. It is believed that deposited embryonated eggs hatch into miracidia which invade terrestrial snails (first intermediate host) that release cercariae. The later are eaten by fish forming infective encysted metacercariae which are consumed by rodents, reptiles and incidentally cats (second intermediate host) (Kok et al. 1992). Currently, stray cats harboring those flukes are captured from areas like the minimal requirements of hygienic measures with a higher possibility of the presence of reptiles and terrestrial arthropods. Feeding habits of cats i.e. predating rodents or reptiles containing encysted metacercariae, infective stages, allow the development of such flukes (Ravikumar et al. 1979). Several species of *Euparadistomum* species are found parasitizing lizards, bats, foxes and other animals (Talbot 1970). In such concern, Gogate (1939) revealed

Fig. 2 Morphology of adult *E. herpestesi*. **a** Carmine-stained specimen of the fluke (Scale bar = 1 mm). **b** Morphological characteristics of *E. herpestesi*. O oral sucker, Ph pharynx, T testes, I intestinal caecum, A acetabulum, Ov ovary, U uterus and V vitellaria, Drs dorsal chamber of receptaculum seminis (Scale bar = 1 mm)

Euparadistomum cerivoulae from the intestine of a bat, *Cerivoula picta* (Pallas 1767), in Tantabin, Insein district, Burma. Moreover, Betterton (1980) described *Euparadistomum* spp. from 7 species of small mammals in Malaysia. The recovered flukes displayed characteristics intermediate between *E. buckleyi* and *E. pearsoni* particularly regarding the body shape and distribution of vitelline glands. Meanwhile, Doanh and Le (2003) recorded *Euparadistomum varani* Tubangui, 1931 from 2 giant lizard species *Varanus nebulosus* (Gray, 1831) and *Varanus salvator* (Laurentin, 1786).

Cats fed incidentally on reptiles and terrestrial arthropods are often infected with *Euparadistomum* species. In this scope, Buckley and Sheng-Liang (1958) recorded *E. heiwtschi* from the liver of a domestic cat in Pate Island, Kenya, and Rajavelu and Raja (1988) elucidated *E. pearsoni* in Papua, New Guinea, *E. buckleyi* from cats in Madras, India. The last literature reported *E. buckleyi* for the first record from a cat in India. The current study revealed co-infections of cats with other helminths, cestodes and nematodes with no characteristic clinical signs appeared. It has been found that concurrent infections with other intestinal parasites are common (Rajavelu and Raja 1988). In reported cases, infections with *Euparadistomum* species showed no clinical signs in infected cats.

To the best of our knowledge, this is the first record of *E. herpestesi* in Egypt. Due to large populations of stray cats in Egypt, it is advisable to do further studies on such fluke to determine all proposed *Euparadistomum* species. Molecular tools are encouraged to identify *Euparadistomum* species in Egypt.

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Author contributions KME necropsied stray cats, collected raw data, identified the flukes and wrote the manuscript. ASA necropsied cats and stained specimens. AAK participated in necropsy and in manuscript formatting. All authors are in consent with this work.

Compliance with ethical standards

Conflict of interest Authors declare that they have no conflict of interest.

Human and animal rights Animals used in the present study were obtained as a result of the cooperation between the Directorate of Veterinary Medicine, Beni-Suef, Egypt and the Faculty of Veterinary Medicine, Beni-Suef. The current work was done according to the ethics Animal and Human Research Committee of the Faculty of Veterinary Medicine, Beni-Suef University, Egypt.

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