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Current Finding of Helminth Morphology Cause Infectious Disease

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Abstract **–** In Indonesia, the prevalence of helminthiasis is still high, especially in children. The frequency is 60-70% in populations at risk. The lack of use of family latrines causes soil contamination with feces around the yard. There are still few articles that review the morphology of worms that cause infectious diseases in Indonesia. Whereas knowledge of morphology is important to understand the life cycle of worms that play a role in disease transmission in humans and mammals. This article aims to discuss the latest findings regarding the morphology of worms that cause infectious diseases in humans. It can be concluded that at the adult stage, worms can be sexed. Usually, the female type has a relatively larger size than the male. On the head (anterior) there are 3 lips that have sensor papillae, one on the mediodorsal and 2 on the ventrolateral. Between the 3 lips there is a bucal cavity which is triangular in shape and functions as a mouth.

Keywords **-** *Morphology, Helminth, Infectious disease*

INTRODUCTION

Many human and animal parasitic diseases are found in Indonesia, because the environment in this area allows parasites to live and reproduce perfectly. Many epidemiological-parasitological studies have shown that within fifty years, the frequency of parasitic diseases of the Indonesian population has not decreased significantly. The 2019 Household Health Survey showed that infectious and parasitic diseases were the main causes of death in Indonesia. The prevalence of intestinal worm infection in Indonesia ranges from 2.2% to 96.3%, indicating a significant difference between one region and another in Indonesia, which has a wide area and different geographical characteristics as well as different socio-economic and cultural characteristics of the population. Researches in Indonesia show that parasitic diseases, which are closely related to the environment, still show a very high frequency in various regions. One of them is soil-transmitted helminths such as ascariasis, trichuriasis and hookworm infection. Researches in Indonesia, for example by conducting stool examinations on the population, both in rural areas and in urban areas, both in Java and outside Java, show that the figures have not changed much. Research in Jakarta on elementary school children shows that the frequency of worm disease is around 49.5%, while research on elementary school children in Bengkayang Regency, Sulawesi, shows the prevalence of intestinal worms is around 52.0%. Lack of clean water facilities, limited land for families to live in, habit of eating with unwashed hands, reuse of leaves and food wrappers that have been thrown into the trash, vegetables eaten raw, use of river water for various necessities of life (bathing, washing groceries, washing clothes, gargling, brushing teeth, and also being used as a toilet), and the use of feces for vegetable fertilizers, increases the spread of parasitic diseases, especially soil-transmitted helminth. [1]

In addition to the factors mentioned above, occupational factors also greatly affect the frequency of parasitic diseases. Plantation workers with inadequate latrine facilities, irrigation and irrigation workers, mining and forestry workers, farmers and ranchers are among the groups that have a high risk of being infected with parasitic diseases. Other parasites that require long-term treatment are Filaria, the worms that cause elephantiasis. According to a 2000 report, 231 districts in 26 provinces in Indonesia are filariasis endemic areas. In Indonesia, there are 3 types of filarial worms

namely *Wuchereria bancrofti, Brugia malayi and Brugia timori*. These three worm parasites can cause lymphatic disorders with the final manifestation of elephantiasis that cannot be treated or rehabilitated properly. The vectors of this parasite are various types of mosquitoes that have different living habits with different types of nests. Some need clear water for their breeding grounds, some need brackish water, swamp water, nests that are protected from the sun or vice versa, some need the warmth of the sun. [2]

In addition to filariasis and soil-transmitted helminths, parasites whose life cycle is closely related to the environment are pork tapeworm (*Taenia solium*) and beef tapeworm (*Taenia saginata*). Several areas outside Java are endemic foci of schistosomiasis, a bloodworm disease that can cause severe clinical manifestations that can lead to death of the patient. In Indonesia, the cause of schistosomiasis is a leaf worm that lives in human blood vessels, namely Schistosoma japonicum. This worm is a zoonotic parasite that can be transmitted from animals to humans and vice versa, requires fresh water as a place for the development of its infective stage. [3]

RESULTS AND DISCUSSION

Ascaris lumbricoides

The *Ascaris lumbricoides* worm has 3 stages of life development, but the larval stage is not widely reviewed so it is better known in 2 stages of development, namely:

1. Eggs: at this stage we can find various forms of eggs including fertile, infertile and decorticated eggs.
2. Adult form: at this stage the worms are found in 2 sexes separate (not hermaphrodites).

The egg stage of this species is oval in shape and ranges in size from between 45-75 microns x 35-50 microns. *Ascaris lumbricoides* eggs are very distinctive with the composition of the egg wall is relatively thick with a bumpy exterior. The egg wall is composed of three layers, namely:

a. Thick outer layer of impermeable albuminoid material.
b. The middle layer of hyaline material is impermeable (this layer gives the egg its shape)
c. The innermost layer of vitelline material is very impermeable as a coating for the egg cell.

Worm eggs are often found in 2 forms, namely fertile eggs (fertilized) and infertile (unfertilized) eggs. Fertile eggs that have not developed usually do not have air cavities, but those that have developed will have air cavities. Fertile eggs that have undergone maturation sometimes experience the outermost egg wall peeling so that the appearance of the eggs no longer has rough lumps but looks smooth. Eggs that have experienced peeling of the albuminoid layer are often said to have undergone a decortication process. In this egg, the hyaline layer is the outermost layer. Infertile eggs; more oval in shape, larger in size, contains dead protoplasm so that it looks more transparent. [4]

At the adult stage, worms of this species can be distinguished by sex. Usually, the female type has a relatively larger size than the male. On the head (anterior) there are 3 lips that have sensor papillae, one on the mediodorsal and 2 on the ventrolateral. Between the 3 lips there is a bucal cavity which is triangular in shape and functions as a mouth. The male sex has a length ranging from 10-30 cm while the diameter is between 2-4 mm. Posteriorly, the tail is coiled ventrally and has 2 spicules. While the female sex body length ranges from 20-35 cm with a body diameter of 3-6 mm. The tail is relatively straight and pointed. [5]

Trichuris trichiura

The developmental stages of *Trichuris trichiura* are eggs and adult worms. The eggs are 50 x 25 microns in size, with a distinctive shape like a wooden crock or melon seed. At both poles the egg has a clear protrusion called the mucoid plug. The protrusions at the two poles of the egg shell are yellowish on the outside and clear inside. At an advanced stage the eggs sometimes appear to already contain worm larvae. The adult worm is shaped like a whip, the anterior part is 3/5 of the body slender like the tip of a whip, while the posterior 2/5 is thicker like the handle of a whip. The size of the female worm is relatively larger than the male worm. Male worms range from 3-5 cm in length with a rounded caudal part, blunt and coiled ventral like a comma. At the tail of this male worm has a pair of refractile spicules. Female worms are 4-5 cm long with a rounded caudal part, blunt but relatively straight. The female worm lays 3,000 – 10,000 eggs per day. [6]

Necator americanus / Ancylostoma duodenale

Female worms are approximately 1 cm long, male worms are approximately 0.8 cm. The body shape of *Necator Americanus* usually resembles the letter S,

while *Ancylostoma duodenale* resembles the letter C. The oral cavity of both types of worms is large. *Necator Americanus* has chitin bodies, whereas in *Ancylostoma duodenale* there are two pairs of teeth. Male worms have a copulatrix. Hookworm eggs are approximately 55 x 35 microns in size, oval in shape with a transparent wall layer of hyaline material. The undeveloped egg looks like the petals of a flower. In further development can contain larvae that are ready to be hatched. [7]

Strongyloides stercoralis

The parasitic female worm, measuring 2.20 x 0.04 mm, is a small, colorless, semi-transparent filariform nematode with a finely lined cuticle. This worm has a long, slender and cylindrical mouth and esophagus. Along the uterus contains a row of thin-walled, ovate and segmented eggs. Free-living female worms are smaller than those living as parasites, resembling a typical free-living rhabditoid nematode and having a pair of reproductive organs. Free-living male worms are smaller than females and have a circular tail. Eggs of parasitic shape, 54 x 32 microns oval in shape with a transparent wall layer. The shape is similar to hookworm eggs, usually laid in the intestinal mucosa, the eggs hatch into rhabditiform larvae that penetrate the glandular epithelial cells and enter the intestinal lumen and exit with the feces. Eggs are rarely found in the stool except after being given a strong laxative. [8]

Wuchereria bancrofti / Brugia malayi / Brugia timori

The life cycle of the parasite occurs in the human body and the mosquito's body. Adult worms called macrofilariae live in the ducts and lymph nodes, while their offspring are called microfilariae in the circulatory system.

a. Macrofilaria

Macrofilaria / adult worms are cylindrical, smooth like milky white threads and live in the lymph system. Female worms are ovoviparous and measuring 55 -100 mm x 0.16 mm, can produce millions of microfilariae. Male worms are 55 mm x 0.09 mm smaller with a circular tail tip ujung

b. Microfilaria

Female adult worms after experiencing fertilization release millions of young worms called microfilariae. The microfilariae for the genera Wuchereria and Brugia have nocturnal periodicity, meaning they are active at night. During the day it stays in the lymph glands and their ducts while at night it moves towards the blood and follows the human blood circulation. Microfilariae measure 200-600 m x 8 m and have a sheath. Microscopically, the morphology of microfilariae species can be distinguished based on: the size of the head space and the color of the sheath in Giemsa staining, the composition of the body nucleus, the number and location of the nucleus at the tip of the tail. [9]

Fasciola hepatica

This worm belongs to the leaf worm group because its body shape resembles a leaf measuring 20-30 mm x 8-13 mm. Hermaphrodite is where in one individual tiger has 2 different sex organs. The reproductive system is ovary. Has a conical protrusion (cephalic cone) on the anterior. Has a mouth suction vanity and a stomach sucker vanity. The uterus is short tortuous. Many branched testes, located in the middle of the body numbered 2 pieces. [10]

Taenia saginata

In the adult stage this worm resembles a long ribbon. The shape is flat with parts of the body that are segmented or segmented. Complete body length from head to tail can reach 4-12 meters. The tapeworm body is divided into a head (scolek), neck and proglottids or segments. This series of segments is sometimes called a strobila. The size of the scolek (head) is between 1 – 2 mm, which around it has 4 suckers without hooks. The number of proglottids is between 1000 – 2000, consisting of immature – mature – and gravid proglottids. Mature proglottids have sex structures such as testicular follicles, which number 300-400 scattered in the dorsal and ovarian fields. The ovary consists of 2 lobes located in the posterior 1/3 of the proglottid. The uterus is in the anterior part of the proglottid, in the gravid proglottid the uterus will form 15-30 branches. At the egg stage has the characteristics of a round shape, measuring 30-40 x 20-30 microns. The egg wall is thick and has a radial stripe around it. On the inside there is an embryo that has 6 hooks which is often called a hexacan embryo. [11]

Taenia solium

Whole adult worms from anterior to posterior body length can reach 2-8 meters. The worm body is divided into the head (scolek), neck and proglottids. The skolek has 4 suckers and has 2 rows of hooks, each containing 25-30 hooks. The scolex ends with the neck, which is continuous with the immature proglottids. The total number of proglottids ranged from 800 - 1000 consisting of immature, mature and gravid proglottids. In immature proglottids, the reproductive organs still do not appear to be formed

because they are the youngest proglottids. The development of organs in new proglottids is seen in mature proglottids. In mature proglottids, sex structures such as testicular follicles are seen, which number 150-200 scattered in the dorsal plane. In addition, because these worms are hermaphrodites, ovaries can also be seen. The uterus is located anterior to the proglottid. In the gravid proglottid, the uterus will form 7-12 branches. Uterine branching is formed as a result of the reproductive process of adult worms where fertilization of male cells in eggs will result in maturation of eggs that are placed in the uterus. The greater the number of eggs produced, the more filling the uterus will be so that the uterus will be completely filled with eggs and form sacs such as branching. The eggs of this worm have a round shape measuring 30-40 x 20-30 microns. The egg wall is very thick with radial lines around the wall as if it were the spokes of a wheel. On the inside of the egg contains an embryo that has 6 hooks called a hexacan embryo. It is very difficult to distinguish them from the eggs of *Taenia saginata* worms, so without information on the origin of the inspection specimens, eggs are often only reported as *Taenia sp.* [12]

Hymenolepis nana

Adult worm populations have bodies that are elongated segments resembling ribbons like other tapeworms, but in relatively small sizes. Overall body length can reach a size of 25-40 mm, body width 1 mm. Also divided into the head (scolek), neck and neck proglottids. The skolek has 4 suckers with a rostellum that has hooks. The proglottids consist of immature – mature – and gravid proglottids which number approximately 200 proglottids. The immature proglottids bordering the neck are relatively difficult to identify because the vital organs inside have not yet been formed and still appear empty. The mature proglottid of this worm has several characteristics from other worms. Hermaphrodite traits always follow worms from the cestodes class, including this species, so that in mature proglottids you will see the presence of male and female vital organs. The testes, which are the male vital organs, have 3 round shaped pieces with 1 on one side and 2 on the other side side by side. One ovary is located in the middle in the form of a bilobus. In gravid proglottids, the uterus is an irregular sac containing many fertilized eggs. This sac-shaped uterus even widens as wide as the proglottids so that it seems that the entire proglottid area is full of eggs. The genital opening as the outlet for worm eggs has begun to appear in mature proglottids. Worm eggs of this species are oval in shape with a size of approximately 30 x 47 microns. The egg wall is relatively thin, while at the poles the egg appears thickened. From the two poles of the thickened egg, 4-8 filaments appear. These filaments usually appear as strands of hair or long, irregular lines. Inside the egg is the oncosphere which contains the embryo. This embryo contains 6 hooks which are called hexakan embryos. [13]

Hymenolepis diminuta

The adult form of this worm is like a tape with the top part is the head (scolek) which ends with the neck and continues with the proglottids. The total length of the adult worm body can reach 30-60 cm, while the width ranges from 3-5 mm. The skolek part of this worm has 4 suckers which are located parallel to the circumference of the head. At the top of the scolek there is no rostellum protrusion. By itself, because it does not have a rostellum, it is also not found a row of hooks as in *Hymenolepis nana*. The end of the head is the neck, which is continuous with the immature proglottids. The strobila of this worm consists of proglottids which are divided according to maturity, namely immature - mature - and gravid proglottids. The total number of proglottids is approximately 800 - 1000 proglottids. The youngest immature proglottids do not yet have a distinctive shape, only the mature proglottids can be seen for their characteristics. Testes in mature proglottids can be found 3 round shape with relatively far apart position, 1 on one side and 2 on the other side with relatively far spread impression. One ovary in the center of the proglottid is bilobed. A genital opening that connects from the uterus in the middle of the proglottid to one side of the proglottid. In the series of mature proglottids, these genital openings appear to always be present on one side. The description of the gravid proglottid of this species is not much different from the previous species, only its size is relatively larger. The width of the proglottid is much longer than the length. This feature has been seen since the proglottid mature. The irregular sac-shaped uterus also appears to be full of eggs piled on this gravid proglottid. The egg stage is similar in shape to *Hymenolepis nana*. The egg shape of this species is relatively round with a larger size than the eggs of *Hymenolepis nana*. The size of the egg reaches 60 x 79 microns. The structure of the egg wall is relatively thick and when observed with moderate magnification, a radial line will appear as in Taenia sp eggs, but not as thick as Taenia sp eggs. The two poles of this worm egg are relatively invisible because the shape of the egg tends to be round. There was also no visible filament in the egg. The oncosphere is clearly visible in this egg with the

embryo inside. As in other species of tapeworm, the embryo in the eggs of this species also has 6 hooks (hexakan embryos). [14]

Enterobius vermicularis

Enterobius vermicularis is a worm that can enter the mouth of the body through food, air, soil that will nest in the large intestine at night, usually female worms lay their eggs in the anus area. The presence of worms in the intestines will cause the sufferer to lose nutrients, causing a deficiency in the body's immune system which causes the disease to develop quickly.

1) Eggs

A female worm produces 11,000 eggs every day for 2-3 weeks, after which the female worm will die. Eggs of this asymmetric shape are colorless, have translucent walls and contain live larvae. The size of Enterobius vermicularis eggs is approximately 30 microns by 50-60 microns. This egg has a shell consisting of two outer layers in the form of albuminous translucent, chemical protection. E. vermicularis worm eggs are rarely found in feces, only 5% are positive in people infected with this disease.

2) Adult worms

The adult pinworm (*Enterobius vermicularis*) is small, colored white. The size of the female worm is much larger than the male worm. The size of the female worm is up to 13 mm, while the male is up to 5 mm long. In the anterior area around the neck, the cuticle of the worm is widened. The characteristic extension of this worm is called the cervical alae. The intestine of this worm is also distinctive in shape because it has a double-bulp-oesophagus. There is no oral cavity in this worm, but three lips are found. The tail of the female worm is straight and pointed while the male has a circular tail. In the area of the posterior end found the presence of spicules and spicules and papillae. Male worms are rarely found because after copulation with the female he immediately dies. [15]

CONCLUSION

Based on the explanation above, it can be concluded that *A. lumbricoides, T. trichiura, N. Americanus, A. duodenale, W. bancrofti, B. malayi, B. timori, S. stercoralis, F. hepatica, T. saginata, T. solium, H. nana, H. diminuta, E. vermicularis* and other types of worms have different morphology. Research on the morphology of these worms is still being developed, especially by using electron microscopy in any other article.

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