

Research Article

DETAILED MICROSCOPIC STUDY OF THE MORPHOLOGY OF THE DIGESTIVE TRACT OF THE FEMALE NECATOR AMERICANUS (HOOKWORM)

Govindarajalu Ganesan

Dept. of General surgery Indira Gandhi Medical College and Research Institute

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ABSTRACT

Objective: To do detailed microscopic study of the morphology of the digestive tract of the female Necator americanus (hookworm).

Methods: All patients who had undergone upper gastro-intestinal endoscopy for a period of 2 years (2017 and 2018) were examined for the presence of parasitic worms.

Results: Out of these patients who had undergone upper gastro-intestinal endoscopy, 20 patients were found to have hookworms in duodenum. The head is curved like a hook and hence it is identified as hookworm.

Conclusion: Hence upper gastro-intestinal endoscopy is a very useful investigation to diagnose hookworm infection especially when the stool examination is negative for its ova or eggs.

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INTRODUCTION

Hookworms are the most common nematodes or roundworms found in the duodenum of human beings while doing upper gastro-intestinal endoscopy. Hookworm is a common cause of anemia especially in the tropical countries. (1 to 11).

MATERIALS AND METHOD

This study was conducted in the department of general surgery, Indira Gandhi Medical College and Research Institute, Puducherry. All patients who had undergone upper gastro-intestinal endoscopy for a period of 2 years (2017 and 2018) were examined for the presence of parasitic worms.

RESULTS

Out of these patients who had undergone upper gastro-intestinal endoscopy, 20 patients were found to have hookworms in duodenum. The parasitic worm found in one of these patients was retrieved out using biopsy forceps and immediately sent for microbiological examination to do detailed microscopic study of the morphology of the parasitic worm.

1. The parasitic worm retrieved out using biopsy forceps has a curved head like a hook. Hence the parasitic worm found in this patient is identified as hookworm.
2. The mouth of the hookworm has two cutting plates. So the parasitic worm found in this patient is identified as Necator americanus and due to the presence of pointed tail it is identified as female Necator americanus.

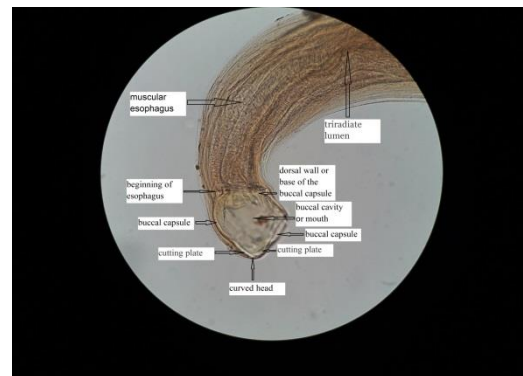


Fig 1 showing Necator americanus with curved head, buccal cavity or mouth with two cutting plates, buccal capsule, beginning of esophagus at the dorsal wall or base of the buccal capsule and muscular esophagus having a triradiate lumen

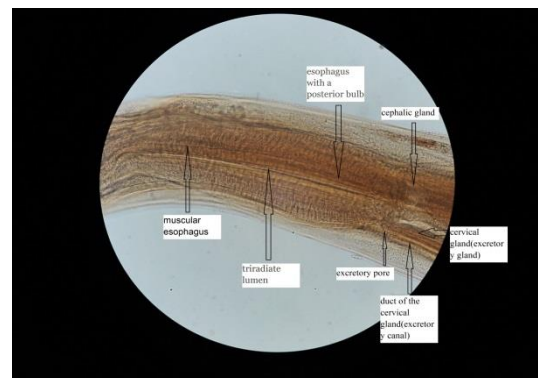


Fig 2 showing Necator americanus with muscular esophagus having a triradiate lumen, posterior bulb of the esophagus, excretory pore near the posterior end of the esophagus, duct of the cervical gland (excretory canal), cervical gland (excretory gland) and cephalic gland

*Corresponding author: **Govindarajalu Ganesan**

Dept. of General surgery Indira Gandhi Medical College and Research Institute

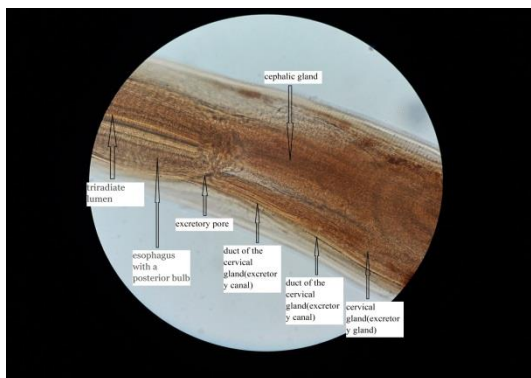


Fig 3 showing *Necator americanus* with triradiate lumen of the esophagus, posterior bulb of the esophagus, excretory pore near the posterior end of the esophagus, duct of the cervical gland(excretory canal), cervical gland (excretory gland) and cephalic gland

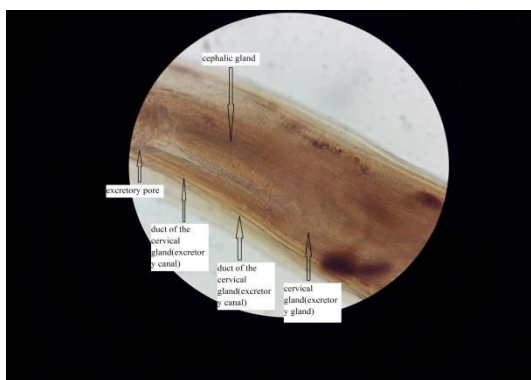


Fig 4 showing *Necator americanus* with excretory pore near the posterior end of the esophagus, duct of the cervical gland (excretory canal), cervical gland (excretory gland) and cephalic gland

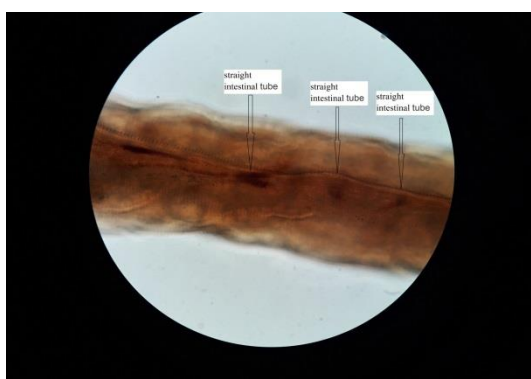


Fig 5: showing female *Necator americanus* with straight intestinal tube

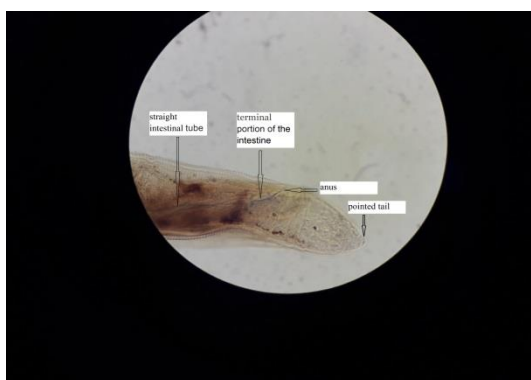


Fig 6 showing female *Necator americanus* with straight intestinal tube, terminal portion of the intestine ending subterminally in the anus and pointed tail.

Digestive tract of the female *Necator americanus*

The alimentary canal or digestive tract of the female *Necator americanus* consists of buccal cavity or mouth(Fig. 1) with two cutting plates(Fig. 1), buccal capsule(Fig. 1), muscular esophagus (Fig. 1 to 3) having a triradiate lumen(Fig. 1 to 3), oesophageal bulb, intestine and anus. The terminal portion of the intestine (Fig. 6) opens subterminally into the anus (Fig. 6). The tail of the female *Necator americanus* is narrow and pointed (Fig. 6).

The esophagus begins at the dorsal wall or base of the buccal capsule (Fig. 1), and extends as a thick-walled, long flask-shaped organ, 700 to 800 microns long and 150 to 175 microns wide at the widest (posterior) part. The oesophagus has a triradiate lumen (Fig. 1 to 3) and consists of a large posterior bulb (Fig. 2, 3). The oesophagus is a muscular tube and contains esophageal gland that secrete digestive enzymes and participate in the extracorporeal digestion.

Near the level of the posterior end of the esophagus is an excretory pore (Fig. 2 to 4) through which opens the duct (excretory canal) of the cervical gland (Fig. 2 to 4). The cervical gland (Fig. 2 to 4) is a large glandular structure lying along the caudal end of the esophagus and the cephalic end of the intestine. The cervical gland (Fig. 2 to 4) is also called as the excretory gland (Fig. 2 to 4). The cephalic gland (Fig. 2 to 4) extends backward from the posterior end of the esophagus. The function of the cephalic gland is not known.

The club-shaped esophagus of *Necator americanus* is very muscular, corresponding to its action as a powerful pump. The esophagus is an efficient pump and forces food into the intestine of *Necator americanus*. In fact, its food consists of intestinal mucous membrane and blood. The adult *Necator americanus* lives in the small intestine of man where it sucks blood, lymph, bits of mucous membrane and tissue fluids from the lining of intestinal wall by the sucking action of the muscular esophagus.

The pathogenesis of hookworm disease is directly related to the attachment of the worms of *Necator americanus* to the intestinal mucosa. Cutting plates in the mouth of *Necator americanus* (Fig. 1) attach to the human intestinal mucosa by biting in plugs of intestinal mucosa (including 7-9 villi), which are stripped off the lamina propria. The pool of blood thus created is sucked in using the muscular esophagus (Fig. 1 to 3). This leads to blood loss and results in iron deficiency anemia. Blood loss occurs when the worms of *Necator americanus* use their cutting apparatus to attach themselves to the human intestinal mucosa and submucosa and contract their muscular esophagus to create negative pressure, which sucks a plug of human intestinal tissue into their buccal capsule (Fig. 1). The oesophagus contains esophageal gland that secrete digestive enzymes. Capillaries and arterioles are ruptured not only mechanically but also chemically, through the action of hydrolytic enzymes. To ensure blood flow, the adult hookworms of *Necator americanus* release anticlotting agents. *Necator americanus* sucks blood, and feed on human intestinal tissue. When worms of *Necator americanus* feed, they pull a plug of human intestinal mucosa into the buccal capsule by esophageal action. The oesophageal gland secretes a ferment which prevents the clotting of blood so that the worm can suck blood from the human host.

DISCUSSION

Necator americanus has a curved head like a hook (Fig. 1).

The intestine of *Necator americanus* is a simple, straight tube (Fig. 5). The intestine has no mesodermal tissue and therefore consists of no muscle layers and tends to be simple, thin, collapsed tube. The intestine is only 1 cell layer thick. The food passes into the long straight intestine of *Necator americanus* where it is digested and absorbed. In female *Necator americanus* the intestine ends subterminally in the anus (Fig. 6). The female *Necator americanus* has a pointed posterior end or pointed tail (Fig. 6).

CONCLUSION

1. *Necator americanus* has a curved head like a hook. At the anterior (head) end there is a buccal cavity or mouth with cutting plates and buccal capsule.
2. The muscular esophagus of *Necator americanus* begins at the dorsal wall or base of the buccal capsule and has a triradiate lumen and consists of a large posterior bulb.
3. Near the posterior end of the esophagus is an excretory pore through which opens the duct (excretory canal) of the cervical gland, a large glandular structure. The cervical gland is also called as the excretory gland. The cephalic gland extends backward from the posterior end of the esophagus.
4. The muscular esophagus of *Necator americanus* is a very efficient powerful pump and forces food into the intestine of *Necator americanus*. In fact, its food consists of human intestinal mucous membrane and blood.
5. Blood loss occurs when the worms of *Necator americanus* use their cutting apparatus to attach themselves to the human intestinal mucosa and contract their muscular esophagus to create negative pressure, which sucks a plug of human intestinal mucosa into their buccal capsule.
6. The intestine of *Necator americanus* is a simple, straight tube. In the female *Necator americanus* the intestine ends subterminally in the anus and the posterior end or tail of the female *Necator americanus* is narrow and pointed.

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