ISSN: 2320-1983 Print ISSN: 2320-1991 Online Volume 2 Issue 1

Applied Cell Biology

Regular Paper

ACB, 2(1), 2013 [1-4]

An illustration of the histomorphology of the Guinea worm (*Dracunculus medinensis)*

Langbong Bimi
Department of Animal Biology & Conservation Science, University of Ghana,
Post Office Box LG 67, Legon – Accra, (GHANA)
E-mail: langbongbimi@hotmail.com; lbimi@ug.edu.gh
Received: 4th January, 2013 ; Accepted: 18th February, 2013

ABSTRACT

In this study, the longitudinal anatomical variation of *Dracunculus medinensis* is investigated and illustrated. At maturity, the gut of the female worm is observed to be completely atrophied and the entire worm is made-up of a larvae-filled uterus. Differences in the musculature from the anterior region, with much thicker muscles to the mid region have been illustrated.

INTRODUCTION

Until the advent of molecular tools for the diagnosis of disease causing organisms, most nematodes were differentiated by observing the key features used as morphological markers for systematic analysis. These makers which are present only on the male worms are rarely ever available for study in the case of *Dracunculus spp* because the male is believed to die immediately after mating[1-3]. Unfortunately, there is no ready-to-use DNA probe yet for the molecular diagnosis of this parasite. There is there fore the need to develop a histomorphologic basis for use in characterization of the parasite.

MATERIALS AND METHODS

The specimens (Guinea worms) for this study were collected mainly from villages in Northern Ghana, declared as endemic for Dracunculiasis (The Guinea worm Disease). Trained worm extractors engaged in the ongoing eradication programme performed all the extractions (Figure 1 & 2). All specimens were pre-emergent worms that were observed on the skin of the patients and about to form a blister to emerge (Figure 3).

Figure 1 : Presenting a Guinea worm being extracted from the foot of a patient

Tissue preparation

Tissue preparations were carried out on formalin-preserved specimens for histologic details. Microscopic examinations were carried out on sections of the mature female worms. The specimens were first thoroughly rinsed with tap water. Pieces measuring 1.0 - 1.5cm long were cut from the anterior, pharyngeal, mid and posterior regions of the specimens for serial sectioning. These were rinsed with tap water and dehydrated at room temperature (29 °C) by passing it through a series of progressively more concentrated alcohol baths for 45 minutes each. Placing in xylene briefly cleared the dehydrated specimens.

Figure 2 : Presenting a Guinea worm being extracted from the arm of a patient

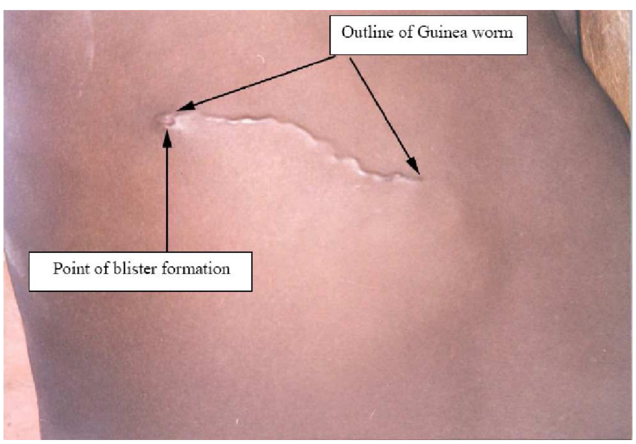

Figure 3 : Presenting a pre-emergent Guinea worm

The cleared pieces of worm were then impregnated with paraffin/candle wax for 24 hours at a temperature of 56°C. These wax-impregnated specimens were imbedded in bocks of candle wax measuring 1cm by 1cm by 2cm. Sections were then cut out using a large rotatory microtome (LR - 85, OSK - 9782; Yamato Kohki Industrial Co. Ltd, Japan). These 8µ sections obtained were de-waxed in xylene and again passed through an alcohol series to re-hydrate. The sections were overstained in Borax Carmine and differentiated briefly in acid-alcohol before counter-staining in eosin. The sections were washed in 70% alcohol after each staining. After counter staining in Eosin, the preparations were again dehydrated briefly in 96% and absolute alcohol respectively and cleared in xylene. The preparations were mounted in dpx and examined under a microscope for morphologic details.

RESULTS

The histomorphology of *Dracunculus medinensis* (the anatomical composition of the worm), was observed to vary along the anterio-posterior axis. There is a progressive change in anatomy anterio-posterialy. As typical of all nematodes, the outer covering of the worm is a tough cuticle. The cuticle was found to be multi-layered, consisting of a cortical, a medial and a basal layer. A well-developed hypodermis, lying between the cuticle and the muscle layer was observed. The hypodermis is thickened in the dorsal and ventral positions to form the hypodermal cords. The muscle cells are the same from the anterior to the posterior regions, although the number and shape vary. They overlap, and depending on the region, they may look large or small.

The Cephalic region

The anterior region was observed to be quite unique. The mouth is triangular in shape and leads into the esophagus, which has a trivoliate, cuticle-lined lumen. The contractile portions of the buccal musculature are well developed and distinct. The non-contractile segments of the longitudinal muscles are however not well differentiated in this region. There are no larvae, implying that the uterus does not extend to this segment of the worm.

The Pharyngeal region

The esophagus is round, but assumes an oval shape towards the upper mid-section of the worm. The muscle cells of the pharyngeal region are well differentiated. Some cells of the non-contractile muscle cells are observed to be nucleated. The esophagus is perpendicularly oriented to the pseudocoel and lies along the axis of the lateral nerve cords. The syncytial hypodermis is also well differentiated here.

The mid-section

The shape at the pharyngeal region is completely modified or differentiated into a circular shape at the mid-section. The pseudocoel here is almost circular and its diameter is considerably increased. There are two bean-shaped identical layers of muscles cells that lie opposite each other. These are separated at either side by the lateral cords where the hypodermis projects into the body cavity. The thickness of the bean-shaped layer of muscle cells progressively decreases from the mid section to the posterior region. The gut is often difficult to see, and almost always displaced by the larvae-filled uterus, and pushed to one side of the body cavity. It is apparently free of any contents. The longitudinal muscle cells are well developed in this region. However, the non-contractile parts of the muscle cells are flattened against the contractile portions and not easily observable.

The posterior section

The characteristic circular shape at the mid-section is maintained at the posterior end of the worm. The

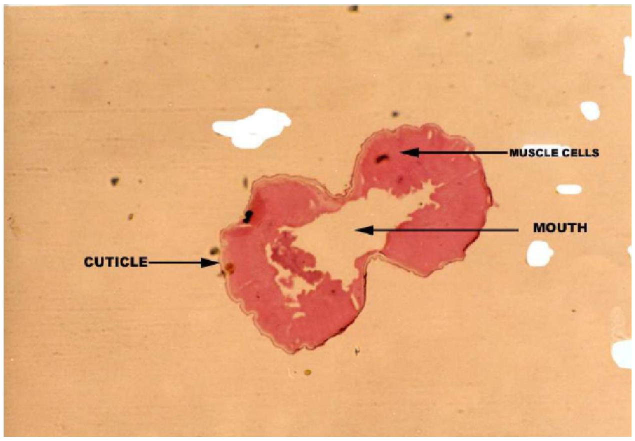

Figure 4 : Presenting the anatomy of the cephalic region of Guinea worm

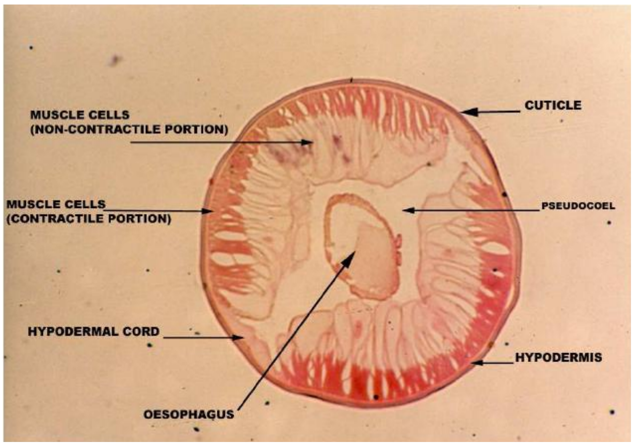

Figure 5 : Presenting the anatomy of the pharyngeal region of Guinea worm

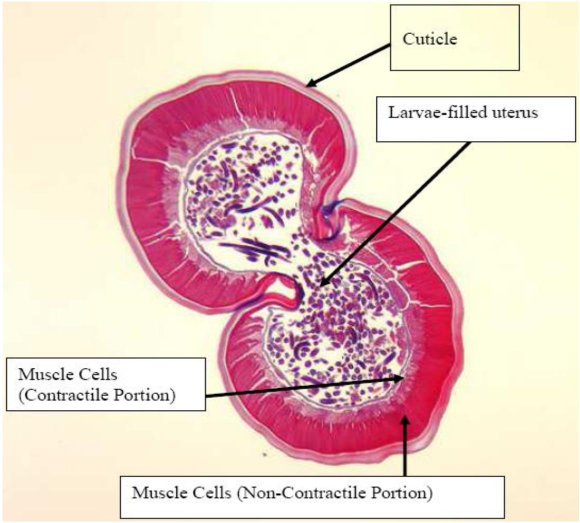

Figure 6 : Presenting the anatomy of the mid-anterior region of Guinea worm

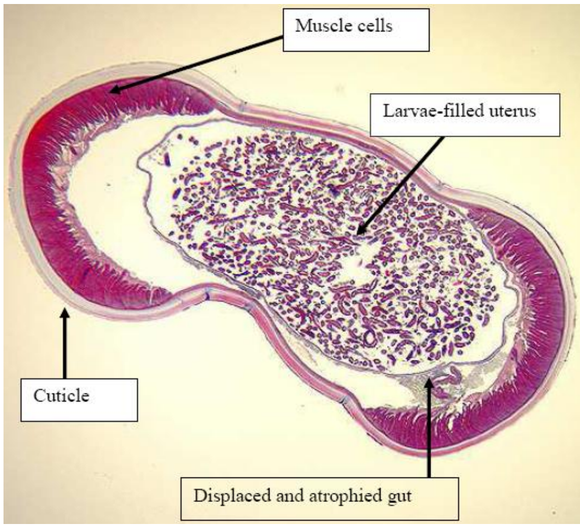

Figure 7 : Presenting the anatomy of the mid-section region of Guinea worm

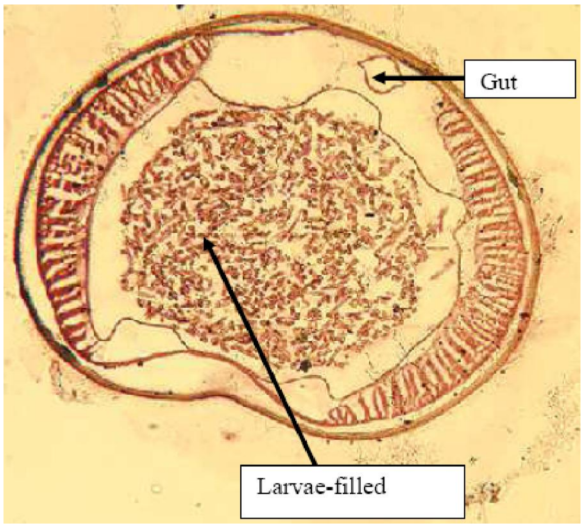

Figure 8 : Presenting the anatomy of posterior region of Guinea worm

thickness of the two bean-shaped muscles is, however, considerably reduced. The larvae filled uterus is still the prominent organelle in this region. The gut is however, markedly reduced to an orifice.

DISCUSSIONS AND CONCLUSIONS

At maturity, the gut of the female guinea worm is observed to be completely atrophied and the entire worm is made-up of the larvae-filled uterus. From this study, a difference in the musculature from the anterior region, with much thicker muscles to the mid region was observed. The thicker muscles could be used for squeezing the larvae out into water by contractions. Thus, by intermittent active expulsions of larvae when exposed segment of worm or blister comes into contact with water. It appears the stimulus for contraction is provided by cold water. It has also been observed that the number of larvae expelled progressively decreases, with the highest coming from the first immersion[4]. This contention is further buttressed by the fact that exposed segment of the worm dries up, and therefore is non-functional. This could account for the subsequent reductions in the numbers of larvae expelled per immersion in water.

ACKNOWLEDGMENTS

I acknowledge the contribution of Mr. Fred Ansah, the Chief Technician of the Department for technical assistance.

REFERENCES

[1] R.C.Anderson; Order spirurida – Suborder spirurina. In: Nematode parasites of vertebrates: Their development and transmission, R.C.Anderson, (Ed); CABI Publishing, New York, 383–590 **(2000)**.

[2] Z.Egyed, T.Sréter, Z.Széll; Morphologic and genetic characterization of *Onchocerca lupi* infecting dogs. Veterinary Parasitology, **102**, 309–319 **(2001)**.

[3] D.D.Bowman, R.C.Lynn, M.L.Eberhard; Helminths. In: Georgis' parasitology for veterinarians. D.D.Bowman, R.C.Lynn, M.L.Eberhard, (Eds); Saunders, Philadelphia, 115–243 **(2003)**.

[4] A.C.Chandler, C.P.Read; Introduction to parasitology. John Wiley and Sons, Inc., New York and London. 503-509 **(1961)**.