THE DEVELOPMENT OF THE EXCRETORY SYSTEM OF CLONORCHIS SINENSIS IN ITS DEFINITIVE HOST

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The flame cell formula of Clonorchis sinensis remains unchanged during its cercaria and metacercaria stage, representing itself as $2\times[(3+3)+(3+3+3)]$ (Komiya and Tajimi, 1940), while Metorchis orientalis, which belongs to the same Family as the former, increases the number of its flame cell during its metacercaria stage. The flame cell formula of its mature cercaria is considered to be $2\times[(6+6)+(6+6+6)]$, but in its metacercaria stage, each tertiary collecting tube except the first one increases one to two flame cells irregularly, thus representing the formula as $2\times[(6+6+(1\sim2))+(6+(1\sim2)+6+(1\sim2)+6+(1\sim2))]$ (Komiya and Tajimi, 1941). When entered into its definitive host, the flame cell formula of Metorchis orientalis shows fundamentally no marked change from that of its metacercaria, at most several flame cells are added to each flame cell group of the tertiary excretory tube (Komiya and Tajimi, 1941).

The purpose of this work is to study the general aspect of the excretory system of Clonorchis sinensis after the entering its definitive host.

MATERIALS AND METHODS

The metacercaria of Clonorchis sinensis was obtained from muscles of naturally infected Sarchocheilichthys nigripennis. Mice were fed with these metacercariae, and after a certain lapse of time, they were dissected and the worm was taken out from the liver. Observation and measurement were made on living materials.

DATA OBTAINED

One day after infection: The worm was already in the liver. The body of the worm was 0.47 mm long and 0.13 mm wide. Its body surface was covered with spines. Pigment granules were found scattered in the body as such were in the case of its metacercaria. No disc like small corpuscles but numerous small granules were found in the intestine. In most cases, no excretory corpuscles were found already in the excretory bladder. The flame part of the flame cell was 8.1μ long. The main excretory canal became considerably larger in diameter. The flame cell formula remained as the same as that of the cercaria and metacercaria: $2\times[(3+3)+(3+3+3)]$.

Two days after infection: The body of the worm was 0.56 mm long and 0.15 mm wide. The acetabulum was still larger than the oral sucker. The pig-
ment granules scattered in the body remained unchanged as before. No excretory corpuscles were found already in every specimen. The main excretory canal became larger, measuring 5.4μ in its diameter. The flame cell formula remained as the same as before.

*Three days after infection:* The body of the worm became 0.73 mm long and 0.19 mm wide; the acetabulum and oral sucker became same in size. Spines of the body surface and pigment granules in the body were still present. The flame cell formula remained still as the same as before.

*Four days after infection:* The body of the worm became 0.91 mm long and 0.24 mm wide. Both suckers were of the same size. Spines of the posterior part of the body had already disappeared. The pigment granules in the body scattered more sparsely because the body of the worm became larger. The flame part of the flame cell was enlarged to 9×4.5μ and the diameter of the main excretory canal measured 7.2μ. In this stage, the flame cell formula still remained unchanged as before.

*Ten days after infection:* The body of the worm became 1.4 mm long and 0.28 mm wide. Both suckers were still of the same size. The number and arrangement of the flame cells in the posterior secondary collecting tube remained unchanged, but a new small flame cell was seen on the foremost original one of both first and second tertiary excretory tubes of the anterior secondary collecting tube (Fig. 2, a). Sometimes, such a feature was found only in the first tertiary collecting tube. The new flame cell was about 1/2 in its size of the original flame cell; the flame part of the latter measured 9×4.5μ. The flame cell formula in this stage was ordinarily $2 \times [(4+4)+(3+3+3)]$.

Fig. 1. The excretory system of *Clonorchis sinensis* in Cercaria and metacercaria stage. a: in cercaria, b: in metacercaria.
Fig. 2. The excretory system of *Clonorchis sinensis* in its definitive host.

a: ten days after infection.  b: twelve days after infection.  c: twenty four days after infection.  d: Ibid.

Explanations:
I: main excretory canal, II: secondary collecting tube, III: tertiary collecting tube. Arabic numerals on the right side of Roman numerals show the rank of each collecting tube.

**Twelve days after infection:** The body of the worm became conspicuously larger, measuring 2.9 mm long and 0.45 mm wide. Particularly, the posterior part of the body was found eminently elongated; it was about three times longer than the anterior part of the body. In this stage, the oral sucker was found rather larger than the acetabulum. The uterus contained yet no egg but was found relatively well developed. Both testes were found already dendriformed. In this stage, the number of the flame cell in each tertiary collecting tube increased considerably in number. Each of three original flame cells of the first tertiary collecting tube was added with 3 to 4 new flame cells which were usually smaller in size, about 1/2 of the original one. The size of the original one was
about the same as that three days after infection. The newly appeared flame cells were found grouped around the original one. On the second tertiary collecting tube, two anterior original flame cells were added with 4 to 5 new flame cells respectively, while the most posterior original one 7 to 8 new flame cells. The size and arrangement of these new flame cells were about the same as those on the first tertiary collecting tube.

Each original flame cell of the third tertiary collecting tube was added with 2 to 5 new flame cells. The increase of flame cells in the fourth tertiary collecting tube was as the same as that of the third one, while each original flame cell of the fifth tertiary collecting tube was added with 2 to 4 new flame cells respectively. Fig. 2, b represents an example of the number and arrangement of the flame cells in the worm in this stage. Here, the flame cell formula on one side was represented as \[(4+4+5)+(6+5+9)\]+[\(3+6+3\)+(3+3+5)+(3+6+5)]\].

**Fifteen days after infection:** The general aspect of the increase and arrangement of the flame cells was about the same as those twelve days after infection. Each original flame cell in the metacercaria stage was found increased by 3 to 9 in number. The number of the flame cells on each tertiary collecting tube was not always constant.

**Twenty four days after infection:** The body of the worm was 5.5 mm long and 1.7 mm wide. Here, the genital organs were found fully developed. In the uterus were found numerous eggs. The diameter of the main excretory canal attained to 7.5μ. But the flame part of the flame cell was not so large as compared with that ten to twelve days after infection. The largest size of the flame part of the flame cell remained yet 9×4.5μ. The size of the flame cell seemed to show no further increase. In this stage the number of the flame cells was found considerably increased, but it was very difficult to elucidate the exact feature of the number and arrangement of flame cells on every tertiary collecting tube, particularly on that locating in the middle part of the body, because here the extensive development of the uterus became an obstacle to the exact observation. With great effort, the authors were able to make clear the aspect of the number and arrangement of the flame cells on the first, second and fifth tertiary collecting tubes. Fig. 2 c and d show an example of the arrangement of flame cells of this stage. As seen in the Figures, each of the original three flame cells on the first tertiary collecting tube increased by 6 to 14 in number respectively, and those of the second and third ones by 10 to 14 in number respectively. No definite factor of division or no dividing regularity of flame cells were recognized in the course of the increase of flame cells. The arrangement of flame cells on the third and fourth tertiary collecting tubes in this stage was not exactly observed by the authors, but the general aspect of the increase of flame cells was considered to be about the same.

From observations above mentioned, it would be almost safe to state that the expansion of the flame cell formula of this worm in its definitive host was
carried out with no regularity, as such is also the case in *Fasciola hepatica* (Kawana, 1941) and Echinoshasmus (Komiya and Tajimi, 1941) in their definitive host.

**SUMMARY**

The flame cell formula of *Clonorchis sinensis* in its definitive host remained as the same as that of its cercaria and metacercaria stage up to about ten days after infection. Later the expansion of the flame cell formula is carried on rapidly. In the course of development, each original flame cell in the metacercaria stage divides itself at six to fourteen in number conveniently. No regularity is found in the division of flame cells in *Clonorchis sinensis* in its definitive host. Such an aspect of the expansion of flame cells in its definitive host is quite similar to that in *Fasciola hepatica* and Echinochasmus.

**REFERENCES**

