CERCARIAL CHAETOTAXY DIFFERENCES AMONG HYPODERAEUM CONOIDEUM (BLOCH, 1782) (TREMATODA: ECHINOSTOMATIDAE) FROM VARIOUS EUROPEAN LOCALITIES

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Received 24 June 1997, accepted 20 December 1997


ABSTRACT: The cercarial chaetotaxy of Hypoderaeum conoideum (Bloch, 1782) (Trematoda: Echinostomatidae) is fully established for specimens emitted by naturally infected Lymnaea peregra (Müller, 1774) (Gastropoda: Lymnaeidae) from the Albufera Natural Park (Valencia, Spain). The main data available on the cercarial sensilla of other descriptions of Hypoderaeum spp. are analyzed. A similar pattern was noted in the different descriptions of H. conoideum, though several differences in the caudal chaetotaxy and dorso-lateral papillae according to the geographical origin of the cercaria may be detected. Evidence of the existence of two different strains of this species in Europe is presented. Affinities between H. conoideum and other species of Echinostomatidae are discussed. Echinopyriophium spp. and Euyparyphium spp. are found to be the most closely related.

KEY WORDS: Trematoda, Echinostomatidae, Hypoderaeum conoideum, cercarial chaetotaxy, Spain.

INTRODUCTION

Hypoderaeum conoideum (Bloch, 1782) (Trematoda: Echinostomatidae) is the type species of the genus Hypoderaeum Dietz, 1909. This is a common and widespread parasite cited in many helminthological surveys parasitizing domestic and wild fowls and, also, mammals, including man (Yokogawa, Harinasuta & Witthaya, 1985). Despite these records, it has only been cited by Gallego, Feu & Torres (1984) and Toledo et al. (1996). The life cycle of this species is known fundamentally due to investigations carried out by Mathias (1924, 1925) and Rees (1932), and several species of lymnaeid gastropods have been recognized as first intermediate hosts of this parasite (see Dubois, 1929; Wessenberg-Lund, 1934; Wiiikren, 1956; Alisauskate, 1958; Ginecinska, 1958; Ginecinska & Dobrovolskii, 1964; Zdarska, 1963, 1964; Williams, 1966; Díaz-Díaz, 1976; Adam & Lewis, 1993; Hass et al., 1995). The cercarial chaetotaxy of this species has been analyzed by Richard (1971) and Grabda-Kazub ska & Kiseilene (1990) on materials from France and Poland, respectively. Despite these investigations, some details appear to be confused and, probably, differences according to the geographical origin may be detected. This shows the need for further studies in order to establish the chaetotaxy pattern of the type species of the genus Hypoderaeum.

During helminthological prospections carried out to investigate the life cycle of the digenean trematodes in the Albufera Natural Park of Valencia (Spain), several species of echinostomes were detected (Toledo et al., 1996; Esteban et al., 1997). In these studies, several specimens of Lymnaea peregra (Müller, 1774) (Gastropoda: Lymnaeidae) were found to be naturally infected with larval echinostomes and shedding cercariae that were identified as H. conoideum. The study of the chaetotaxy of this cercaria and its comparison with the other descriptions of this species could be useful in order to establish the importance of the chaetotaxy differences detected in H. conoideum cercariae by the different authors.

The purpose of the present paper is to report the chaetotaxy of the cercaria of H. conoideum emitted by L. peregra in Spain and to compare it with other descriptions of this species in Europe, in order to establish its chaetotaxy patterns.

MATERIAL AND METHODS

The cercarial chaetotaxy of H. conoideum was studied in 75 specimens emitted from a pool of naturally infected L. peregra collected in the rice fields of the Albufera Natural Park (Valencia, Spain). Cercariae were stained with 3% silver nitrate, exposed to UV light, washed in distilled water and mounted after dehydration in Canada balsam according to the methodology proposed by Combes et al. (1976). Figures were made with the aid of a camera lucida.

The description of the chaetotaxy is based on the scheme and nomenclature adopted by Baysse-Dufour (1979), with some changes proposed by Grabda-Kazub ska & Kiseilene (1989) concerning the cephalic rings. The most dorsal transverse row of papillae (recognized by Richard, 1971 and Baysse-Dufour, 1979, as belonging to the first corporal ring AI) is included in the cephalic ring CI. These papillae are prepharyngeal and appear to be directly connected with the central nervous commissure (Grabda-Kazub ska & Morkzon, 1988).

Specific determination, from the cercariae to adults, was proven experimentally. Metacercariae were reared in a series of small snails - L. peregra, Lymnaea palustris (Müller, 1774), Physa acuta (Draparnaud, 1805) (Gastropoda: Physidae) and Gyraulus chinensis (Dunker, 1848) (Gastropoda: Planorbidae) - previously exposed to cercariae. Adults were obtained from young chickens that were fed with 60-day-old metacercariae. Adult diagnoses were carried out after Toledo et al. (1996).
Fig. 1.—Cercarial chaetotaxy of _Hypoderaeum conoideum_ (Bloch, 1782) from naturally infected _Lymnaea peregra_: A, B, C) cephalic chaetotaxy in ventral, dorsal and lateral views; D) schematic representation of the cephalic chaetotaxy; E) tail chaetotaxy in lateral view; F, G, H) body chaetotaxy in ventral, dorsal and lateral views. Scale bars: A = 40 μm; B = 25 μm; C = 20 μm; E = 80 μm; F = 75 μm; G = 50 μm; H = 100 μm.
RESULTS

A total of 63 (1.5%) among 4012 specimens of L. peregra collected were found to be naturally infected with *H. conoideum* and shedding cercariae. No other snail species, although listed by various authors as hosts of *H. conoideum* cercariae, was found to be infected with this parasite.

**Cephalic chaetotaxy:** it comprises 4 rings (Fig. 1 A, B, C, D):

- **Cl:** 1 Cl V + 1 Cl I + 2 Cl D (or 3 Cl L)
- **CII:** 3 Cl V + 5-6 Cl I + 17-20 H
- **CIII:** 3 Cl V + 3 Cl I L + 8 Cl L 2 + 4-5 Cl D
- **CIV:** 4 Cl V + 3 Cl I L + 3 Cl I 2 + 3-4 Cl I 3 + 2 Cl I 4 + 5 Cl I DL + 4 Cl D.

Moreover, there are some larger composite papillae distributed as follows: 1-2 papillae in group H, 4-5 in Cl I 2 and 3 in Cl I 3.

**Body chaetotaxy:** all the papillae, except the dorso-ventral ones, are distributed in 7 transverse axes corresponding to nervous commissures (GRABDA-KAZUBSKA & MOCZON, 1988). They are distributed as follows (Figs. 1 F, G, H):

- **AI:** 2 Al V + 1 Al L + 0 Al D
- **AII:** 3 Al I V + 1 Al I L + 3 Al D
- **AIII:** 2 Al III V + 1 Al III L + 2 Al III D
- **M:** 2 M V + 3 M I L + 1 M D
- **PI:** 0 PI
- **PH:** 1 PH V + 1 PH I L + 0 PH D
- **PH:** 1 PH IV + 2 PH III L + 0 PH III D

One composite papilla is located in the M I area. Dorso-lateral papillae range from 25 to 30 in number (mean: 27.1) and are situated in the anterior part of the body, except three of them in the posterior part.

**Acetabular papillae:** they are distributed as follows (Fig. 1 F):

- **S:** 1 SI + 3 SI L + 2 SI II

**Tail papillae:** they consist of 4 rows of papillae -2 ventral and 2 dorsal (Fig. 1 E). The ventral rows are comprised of two papillae (92.0% of the cercariae studied) arranged according to the formula \(a + b\) (where \(a = 1\) and \(b = 1\)), though one papilla (8.0%) was detected. The dorsal rows are comprised of 21-25 papillae (mean: 22.9) distributed according to the formula \(x + y + 1\), \(x\) and \(y\) being almost equal. Anterior to excretory pore there is one papilla (84.0% of the cercariae studied), though two (15.0%) and three (3.0%) have also been detected.

DISCUSSION

The cercarial chaetotaxy of *H. conoideum* has been described to date on materials emitted by *L. ovata* (Draparnaud, 1805) from France (RICHARD, 1971) and, recently, on cercariae emitted by *L. palustris* and *L. stag-
Table 1. Cercarial chaetotaxy of *Hypodermaeum* spp. *n* = nomenclature of the papillae not reported by the author, interpreted according to the figures. **= this author only considered three cephalic rings and 6 longitudinal axes; *** = groups of papillae not reflected in the figures of the original paper.

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Tail chaetotaxy

| UV (a+b) | 1+2 | 1+1 | 1+1-2 | 1+1 |
| UD (x+y+1) | 27-30 | 24-25 | 20-28 | 21-25 |

Rope. One of them develops in southwestern Europe (France and Spain) and utilizes *L. ovata* and *L. peregra* as first intermediate host, and the other one develops in northeastern Europe (Poland) and uses *L. palustris* and *L. stagnalis* as first intermediate host. Both strains can be differentiated on the basis of their cercarial chaetotaxy, basically by the number of dorso-lateral papillae and the caudal chaetotaxy. We consider that this point should be
explored further because *H. conoideum* is the type species of the genus *Hypoderaeum* and it may be important for future taxonomic questions in this genus.

In order to establish the importance of the chaetotaxy differences between both strains of *H. conoideum*, the cercarial chaetotaxy of this species has been compared with that of *H. dingeri*, the other member of the genus *Hypoderaeum* with known cercarial chaetotaxy. The analysis of the cercarial chaetotaxy of *H. dingeri* emitted by *L. rubiginosa* (Michelin, 1831) in Malaysia and described by LIE (1966) only permits the recognition of some groups of papillae. This author only reported several scarce drawings - except those on the tail - and without nomenclature. An interpretation of these drawings is updated in Table 1. The cephalic chaetotaxy of our cercaria is highly similar in CIV ring though it differs in H (17·20 vs 22·25), CIII L1 (3 vs 5) and CIII D (4·5 vs 2) groups. The C1 ring is not compared because it was not reflected in the paper of LIE (1966). Comparison of the body chaetotaxy shows that our specimens only differ from those of LIE (1996) in AIII V (2 vs 1). Indeed, the PIII group and lateral and dorso-lateral papillae were not reflected by LIE (1966). Probably the most significant difference may be detected in the number and arrangement of the caudal papillae. *H. dingeri* presents three papillae in the UV group (arranged as 1 a + 2 b) instead two papillae in our cercaria (arranged as 1 a + 1 b). Moreover, the number of UD papillae is greater in *H. dingeri* (27·30 vs 21·25). Comparison of *H. dingeri* with *H. conoideum* from Poland shows that both cercariae are very similar, particularly in the caudal chaetotaxy. These facts show that specific diagnoses in the genus *Hypoderaeum* are difficult on the basis of the cercarial chaetotaxy because the two known cercarial chaetotaxies in this genus are similar. However, the cercarial chaetotaxy of the northeastern European strain of *H. conoideum* appears to be more similar to that of *H. dingeri* than the southwestern European strain of *H. conoideum*.

As compared with other echinostomatid cercariae having known chaetotaxy, the cercariae of *H. conoideum* greatly resemble those of species of *Echinoparyphium* and *Euparyphium* Dietz, 1909 (LIE, 1966; RICHARD, 1971; BAYSSADE-DUFOR & MARTEAU, 1973; LIE & NASEMARY, 1973; LIE et al., 1975; DIMITROV, KANEV & BUSTA, 1985; GRABBA-KAZUBSKA & KISLJENIE, 1989, 1991; DIMITROV, 1990; KISLJENIE & GRABBA-KAZUBSKA, 1990; TOLEDO et al., 1998). These species display a similar pattern, though generic differences may be detected in the CIV D group (4 in *Hypoderaeum* vs 3 in *Echinoparyphium* and *Euparyphium* species) and tail chaetotaxy (4 caudal axes in *H. conoideum* and *Echinoparyphium* vs 2 in *Euparyphium*) (see TOLEDO et al., 1998). However, it should be mentioned that *Echinoparyphium mordwikoi* display a similar pattern to *H. conoideum* in the CIV D group, which may be due to the different intermediate host utilized by this species with respect to the other *Echinoparyphium*. Comparison of *H. conoideum* with other echinostomatid cercariae shows greater differences, particularly in CIV DL and CIV D groups (5 and 4 in *H. conoideum* vs 3 and 2 in *Echinostoma* spp. and 4 and 2 in *Mollieniella* spp.) (LIE, 1966; LIE & BASCH, 1966, 1967; HSC, LIE & BASCH, 1968; RICHARD, 1971; JAYARASINGAM et al., 1972; BAYSADÉ-DUFOR & MARTEAU, 1973; LIE & NASEMARY, 1973; RICHARD & BRYGOO, 1978; BAYSADÉ-DUFOR, 1979; DIMITROV et al., 1985; KANEV et al., 1987; NASSI & DUPLOY, 1988; DIMITROV & KANEV, 1991, 1992).

According to all the above, the cercarial chaetotaxy of the representatives of the genus *Hypoderaeum* appears to be greatly homogeneous, particularly as regards the chaetotaxical groups considered by TOLEDO et al. (1998) to be characteristic of this genus. Nevertheless, small differences may be detected in *H. conoideum* according to the geographical origin. However, further studies should be carried out because the cercarial chaetotaxy of *Hypoderaeum* is only represented by two species. These studies could contribute to the definitive specification of the chaetotaxy patterns of the cercariae of species of the genus *Hypoderaeum*.

**ACKNOWLEDGEMENTS**

This study was supported by Spanish DGICYT Projects (PB87-0135 and PB92-0517) of the Ministerio de Educación y Ciencia (Madrid, Spain). Thanks are also due to the Dirección Territorial de la Consellería de Medi Ambient de la Generalitat Valenciana (Valencia, Spain) for the license to collect host materials in the field. The authors wish to thank L. Sánchez and M. Pérez (Valencia) for their technical collaboration. This work has been carried out while the second author (C.M.A.) held a pre-doctoral fellowship from the Conselleria d’Educació i Ciencia de la Generalitat Valenciana (Valencia, Spain).

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