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POLYCYSTIC ECHINOCOCCOSIS IN COLOMBIA: THE LARVAL CESTODES IN INFECTED RODENTS

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Abstract: Described are the characteristics of the polycystic larval cestodes found in an endemic area of echinococcosis in the Easter Plains of Colombia and the tissue reaction evoked in infected rodents. Of 848 free-ranging animals examined, polycystic hydatids were found in 44/93 *Cuniculus paca* and 1/369 *Proechimys* sp. None of 20 *Dasyprocta fuliginosa* examined was infected, but hunters provided a heart with hydatid cysts and information about two additional animals with infected livers. Recognition of an endemic area of polycystic echinococcosis provides a means to investigate the life cycle of the parasites and to study the histogenesis of the larval cestodes in susceptible laboratory animals.

INTRODUCTION

Of the several species of *Echinococcus* described from the strobilar stage, four are accepted as valid: *E. granulosus, E. multilocularis, E. oligarthrus* and *E. vogeli.*[4] The taxonomic status of a fifth species, *E. cruzi,* known only as a polycystic hydatid cyst is uncertain.[1] The larval stages occur naturally in domestic and wild animals, having either an expansive or infiltrative growth. The latter characteristic of *E. multilocularsis* is accomplished by exogenous proliferation, the tissue destruction paralleling that of malignant neoplasms.

This paper describes the characteristics of the polycystic larval cestodes found in an endemic area of echinococcosis in the Easter Plains of Colombia, and the tissue reaction evoked in infected rodents.

MATERIALS AND METHODS

The study area included the Carimagua Experimental Station of the Instituto Colombiano Agropecuario (ICA), and the neighboring ranches of Caviona, Nueva Colombia, Carraba, Alta Gracia, La Portuguesa and La Florida, with a total area of approximately 500 km.[2]

The location of Carimagua is: lat. 4°30 N, long. 7°30 W. Annual rainfall is 1,800 to 2,000 mm, distributed from April through November. A marked dry season occurs from mid-December through late March. Mean annual temperature is 26-27 C, with a range of 20-30 C. Elevation is 150-157 m. and the topography is characterized by smooth interfluvial savannhas with slopes of less than 0.5%. Side slopes seldom exceed 3%, dropping to well-defined drainageways lined with gallery forests of deciduous hardwood and palm.

Free-ranging wild mammals were collected by trapping or shooting from October, 1972 to November, 1976. Trapped specimens (Table 1) were transported to the field laboratory, anesthetized by ether inhalation and bled from the heart for blood and serum analysis. The animals were then killed for necropsy. The same methods were followed in the field for animals which were shot.

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TABLE 1. Polycystic hydatid cysts in wild animals from the Easter Plains of Colombia.

Mammalian Order	Species	No. positive/ No. examined
Bats	*Phillostomus hastatus*	0/1
	Carollia perspicillata	0/7
	Myotis nigricans	0/5
	Lasiurus borealis	0/1
	Molossus major	0/5
	Eumops bonariensis	0/1
Carnivores	*Cerdocyon thous*	/5
	Felis pardalis	0/1
	Felis yagouaroundi	0/1
	Potos flavus	0/3
Edentates	*Dasypus kappleri*	0/7
	Dasypus novemcinctus	0/1
	Dasypus sabanicola	0/4
	Priodontes giganteus	0/5
	Tamandua longicaudata	0/2
Lagomorphs	*Sylvilagus floridianus*	0/8
Marsupials	*Didelphis marsupialis*	0/74
	Philander opossum	0/2
	Lutreolina crassicaudata	0/2
	Marmosa murina	0/36
	Metachirus nudicaudatus	0/13
Primates	*Aotus trivirgatus*	0/3
	Callicebus moloch	0/12
	Cebus apella	0/8
Rodents	*Coendu* sp.	0/3
	Cavia porcellus	0/9
	Cuniculus paca	44/93
	Dasyprocta fuliginosa	0/20
	Hydrochoerus hydrochaeris	0/57
	Neacomys spinosus	0/11
	Nectomys squamipes	0/23
	Oryzomys concolor	0/20
	Oryzomys delicatus	0/3
	Proechimys sp.	1/369
	Sigmodon sigmomys	0/2
	Zygodontomys brevicauda	0/24
Ungulates	*Odocoileus virginianus*	0/3
	Tayassu sp.	0/4
TOTAL		45/848

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Tissues for histologic examination were collected when gross abnormalities were seen at necropsy. For this particular study, they were fixed in 10% buffered formalin, prepared by the paraffin embedding method and stained routinely with haematoxylin and eosin (H&E). The periodic acid-Schiff method (PAS) was used selectively.

RESULTS

A total of 848 free-ranging wild mammals, belonging to 8 mammalian orders was examined (Table 1). Polycystic hydatid cysts were found in 44/93 pacas, *Cuniculus paca,* and 1/369 spiny rats, *Proechimys* sp. None of 20 agoutis, *Dasyprocta fuliginosa,* examined in this series was infected, but local hunters provided a heart with hydatid cysts and information about two additional animals with infected livers. We were told that in the first agouti, hydatids also were seen in the liver, muscles and other organs. With the exception of one paca, lesions were located in the liver parenchyma. This paca had a single cyst, caudal to the right kidney, attached to the peritoneum. In the spiny rat cysts were located in the liver, spleen and the serosa around the stomach.

Macroscopic findings varied according to the size and location of the larval cestodes. Early stages in the liver of pacas were characterized by the formation of discrete yellowish granulomata both at the hepatic surface, and deeper in the hepatic tissue. Early stages measured 1 to 1.5 mm in diameter. No



FIGURE 1. Liver of paca. Spherical to subspherical cystic structures 10 mm in diameter and larger, bulging from the surface. Hepatic lobes have been replaced almost entirely by larval tissue.

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cystic cavities were seen at this stage. Larger lesions were characterized by spherical to subspherical translucent cystic structures, 4 to 10 mm (or larger) in diameter, bulging from the liver surface. Interconnected cystic cavities were readily seen deep in the parenchyma. In some cases hepatic lobes had been replaced almost entirely by larval tissue (Fig. 1). Transected cysts had a clear to turbid fluid containing minute particulate matter. Few had a centrally located slightly yellowish amorphous material. Foci of necrosis and calcification were readily seen within the invading tissue masses. Metastases to lung and other organs were not seen.

The polycystic hydatid cysts found in the heart of *D. fuliginosa* were attached to the pericardial sac, the epicardium and also had invaded the myocardium, bulging into the ventricular chambers. Those found in the spiny rat were smaller but had the same appearance as those described in the liver of pacas.

Initial histologic changes in the liver of pacas were characterized by a severe host tissue reaction, with the larval cestodes embedded in a mass of necrotic tissue surrounded by an inner adventitial layer of epithelioid cells arranged radially, and an outer zone of fibrous tissue with a dense peripheral infiltration of lymphocytes, plasma cells and eosinophils (Fig. 2). More advanced lesions had foci of necrosis, calcification in the intercystic connective tissue and a laminated membrane, clearly related to

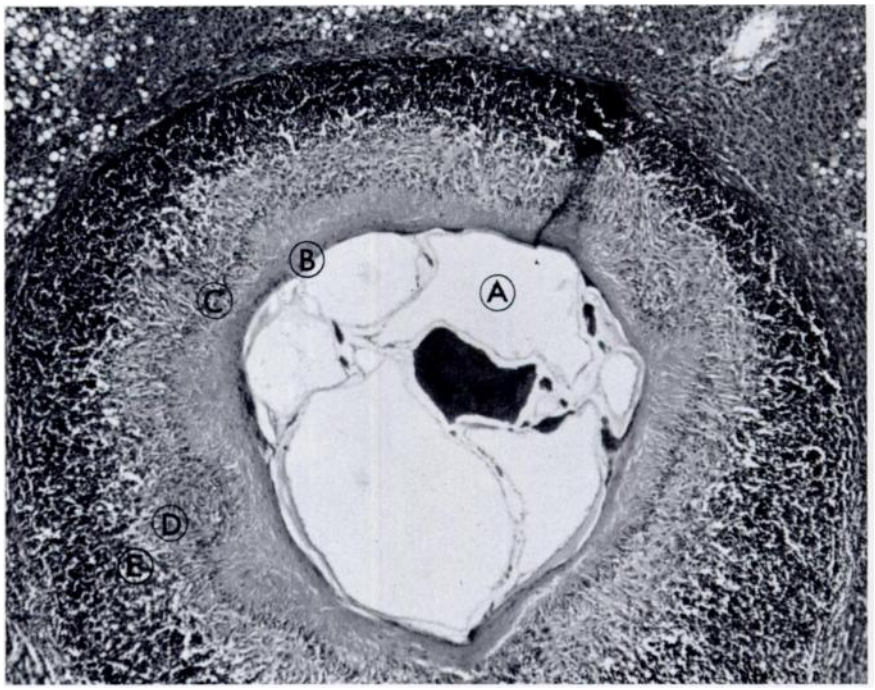


FIGURE 2. Early hepatic lesion in paca. The polycystic larval cestode (A) is embedded in a mass of necrotic tissue (B) surrounded by epithelioid cells arranged radially (C), and an outer zone of fibrous tissue (D) infiltrated peripherally by a dense mass of lymphocytes, plasma cells and eosinophils (E). H&E × 50.

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exogenous cystic proliferation (Fig. 3). Well-established lesions were characterized by the disappearance of the epithelioid cells, the laminated and germinal membranes being surrounded by a thick fibrous capsule, and a mild infiltration of lymphocytes. At this stage, brood capsules, protoscolices and calcareous corpuscles were numerous in most cysts (Fig. 4). External proliferation of the larvae occurred together with regressive changes characterized by marked thickening and amorphous appearance of the laminar membranes, necrosis of protoscolices, and linear calcification of adventitial layers.

The histologic appearance of polycystic hydatids from agouti and spiny rat was similar to that observed in late stages of larval development in pacas. However, the pericystic reaction in the myocardium of the agouti showed an intense lymphocytic and plasmacytic infiltration (Fig. 5).

DISCUSSION

Thatcher[5] reported polycystic hydatid cysts in four spiny rats *(P. guayannensis)*, one paca and one opossum *(Didelphis marsupialis)*. Although transmission studies were not done, he considered the larvae to be *E. oligarthrus*. In the same geographic area, D'Alessandro[2] found adult *E. oligarthrus* in 1 of 1 *Felis yagouaroundi* and in 1 of 3 *Felis pardalis;* and *E. vogeli* in 1 of 2 hunting dogs. Therefore the polycystic hydatid cysts observed in Colombian pacas, agoutis and spiny rats may be *E. vogeli, E. oligarthrus* and/or *E. cruzi*. Transmission studies and de-



FIGURE 3. Liver of paca. Calcification in the laminated membrane of a hydatid, related to exogenous cystic proliferation. H&E × 100.

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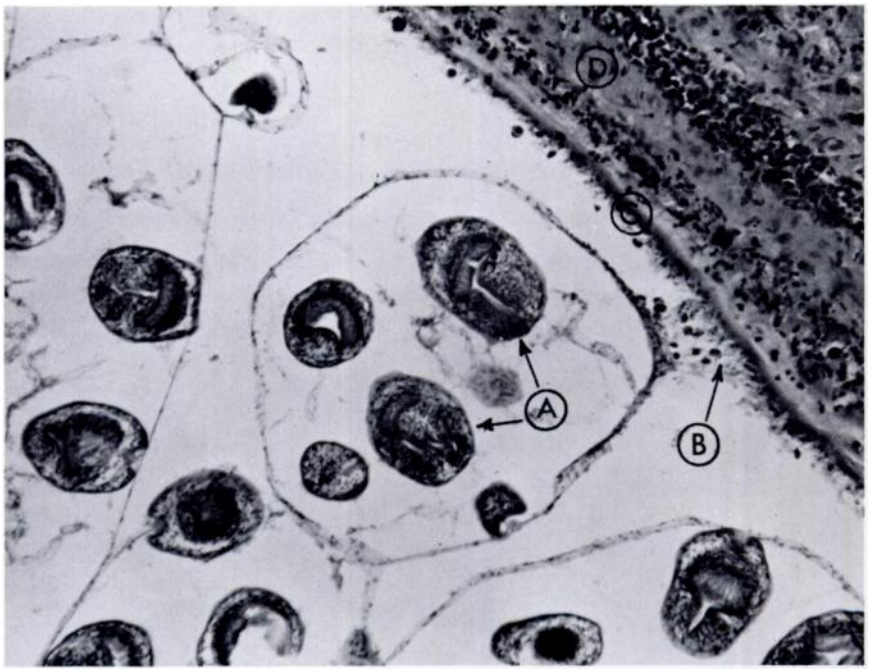


FIGURE 4. Hydatid in the liver of paca. Brood capsules containing protoscolices (A), calcareous corpuscles in the germinal membrane (B), laminated membrane (C), and host tissue reaction (D). H&E × 125.

tailed morphologic examination of larvae of known origin should provide the information needed to differentiate the polycystic hydatid cysts of these two neotropical species of *Echinococcus*.

In pacas, liver seems to be the primary locus of infection. All hydatid cysts were polycystic except for a few young simple cystic structures. Thatcher[5] pointed out that cysts begin as simple hydatids and later bud exogenously and endogenously. In early infections individual cysts are minute, but readily identifiable microscopically when stained by the PAS method; the laminated membrane is strongly PAS positive.

A characteristic feature of *Echinococcus* cysts, for purposes of comparative morphology, is the nature of the laminated membrane of the cyst wall. In cysts studied by the present authors, laminated membranes varied from thin undulating to thick and homogeneous, even in individual infected hosts. Possibly the microscopic appearance of these structures in naturally-infected animals depends upon age, species and immunological status of the host; specific location of the larval cestode; stage of development at time of examination; and methods of handling and preparation of specimens. The real taxonomic significance of these findings has yet to be assessed.

Excessive growth and infolding within few cystic structures of the laminated and germinal membranes was notable in advanced lesions. This process seems to be closely related to the ability of polycystic hydatid cysts to invade neighboring tissue.

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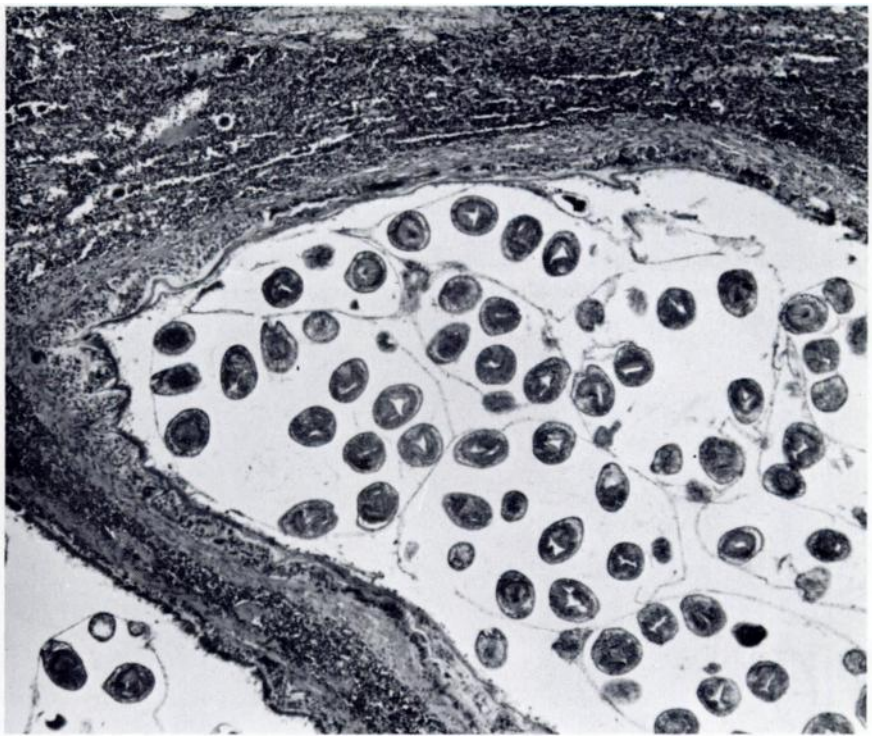


FIGURE 5. Polycystic hydatid cysts in the myocardium of *Dasyprocta fuliginosa*. Intense lymphocytic and plasmacytic infiltration at the periphery of fully developed cysts. Protoscolices and brood capsules are numerous. H&E × 50.

Necrosis and calcification in the intercystic connective tissue related to exogenous cystic proliferation, as seen in our cases, also has been described in *E. multilocularis* infections by Ohbayasi *et al.* In this study, these early calcifying changes were usually accompanied by the appearance of early brood capsules and later by protoscolices and calcareous corpuscles with the formation of fully viable cysts.

Discovery of an endemic area of polycystic echinococcosis makes possible the investigation of the life cycle of the parasite(s) involved, as well as the systematic chronologic study of the histogenesis of the larval cestodes in susceptible laboratory animals.

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