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Mast Cell Response to Cestode Infection. (28067)

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Mast cells participate, to some degree, in inflammation, neoplasia, wound healing, and anaphylaxis(1). These cells, by their sudden release of large amounts of histamine induce hyperemia and infiltration of tissue by blood elements at the site of an inflammation(1). This report describes the appearance of mast cells in the circulating blood, and their presence in the wall of a cestode liver cyst, as a response to invasion by a tapeworm, probably *Hydatigena taeniaeformis*.*

Materials and methods. Male Sprague-Dawley rats, 3-4 months of age and 200-300 g weight, were used. Five rats with infections of the larval cestode (*Cysticercus fasciolaris*, larval stage of *H. taeniaeformis*) and 5 non-infected rats were studied.

Liver, spleen, lung, heart, stomach, jejunum, kidney, and testis were prepared histologically by the paraffin technic (5 μ sections) and examined by bright field at 1250 diameters. Stains used were hematoxylin and eosin, toluidine blue (0.05% in 70% ethanol at pH 7.5 for 1 minute, with alcoholic extraction by 95% ethanol for 15 minutes)(2), and periodic acid-Schiff (P.A.S.)(3). Blood films were taken by cardiac puncture and stained with Wright's stain. Measurements were made by optical micrometer. The method of Floderus(4) was used to count mast cell populations. In particular, mast cell counts of liver were made on representative cross-sections of several entire lobes.

Results. Erythrocytes with Howell-Jolly bodies and globular mast cells were found in cardiac blood. There were 10-12 mast cells in each film. Mast cells were distinctly different from basophils in structure and in staining properties.

The mast cells were 30-35 μ in diameter, with a light blue, spheroid nucleus about 8 μ in size; and contained numerous large cytoplasmic granules. Whereas, basophils were approximately 15 μ in diameter, with a deep blue, polymorphic nucleus less than 8 μ in size; cytoplasmic granules were fewer and smaller than those of the mast cells.

In each of the infected rats, there was a well-developed, unruptured cyst in the upper right lobe of the liver, impinging on, but not penetrating, the diaphragm. The encysted parasite had a structure similar to that of a unilocular hydatid cyst. The cysts were 5-6 mm in diameter and the infections were estimated to be of 2-4 months duration. The cyst wall (Fig. 1) was 90 μ thick and was composed of 3 layers: 1) an outer cellular layer *ca* 35 μ thick, containing endothelial cells, eosinophils, and fibroblasts, which was vascularized by blood capillaries; 2) an inner fibrous layer *ca* 50 μ thick containing many types of cells; and, 3) a germinal layer *ca* 3 μ thick was produced by the parasite, within the first 2 layers and lining the cyst lumen. The interior of the cyst contained the developing body of the parasite.

Mast cells could be located easily by comparing serial sections stained alternately in toluidine blue and hematoxylin and eosin. Mast cells could be observed with H & E alone, but because they stained so deeply with hematoxylin their granular nature was

* Identified by Dr. L. A. Stauber.

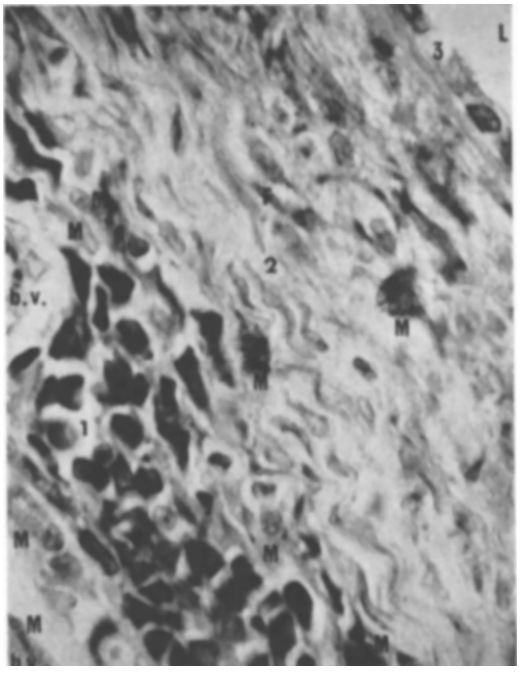

FIG. 1. Section of cyst wall of *Hydatigena taeniaeformis* stained with toluidine blue (340×) showing its 3-layer composition: 1) a cellular layer containing endothelial cells, eosinophils, fibroblasts, and mast cells; 2) a fibrous layer; and 3) the germinal epithelium of the parasite. Mast cells (M) are present in the 2 host layers (1 and 2). Blood vessels (b.v.), fibroblasts (F), and lumen of the cyst (L), are indicated.

obscured and positive identification was difficult. In sections stained with toluidine blue, the fusiform mast cells of the cyst wall were from 25-38 μ in their long axis and appeared with pink-red metachromatic cytoplasmic granules and a light blue spherical nucleolus, or nucleoli, was present in many of the mast cell nuclei. When the nucleus was clearly exposed, dark blue thickenings on the nuclear membrane were seen. Application of the periodic acid-Schiff reaction showed the mast cells to be moderately P.A.S.-positive, in agreement with the work of Montagna(2).

Mast cells were present in both the inner and outer layers, and in relatively lesser numbers among the surrounding liver cells. Counts of the mast cell populations in liver of infected animals were from 2000-3000 mast cells per mm^3, as contrasted with counts in non-infected liver of 100-200 mast cells per mm^3. Counts of the mast cell population in the 2 outermost layers of the cyst wall taken together showed approximately 24,000 mast cells per mm^3.

Histological examination of liver, spleen, lung, heart, stomach, jejunum, kidney and testes from the infected animals disclosed no additional sites of infection and mast cell populations were within normal limits as compared to counts in normal animals. Incidentally, no sarcomatous liver growths were present in any of the infected animals.

Discussion. Infection by the parasite *Hydatigena taeniaeformis* is common in the cat, as the specific host, and in other felines. It can be identified from the type and structure of the cyst stage, manner of germinal proliferation, and rostellar armament of the developing scolex. This cestode is often reported in rats. Its origin is probably fecal contamination.

Mast cells are not often reported in the circulating blood and are not usual in non-infected animals. An exception is the frog where mast cells are a normal blood element, in addition to basophils. In rats with various pathological conditions, blood mast cells are commonly seen. In the present instance, the combination of Howell-Jolly bodies and blood mast cells is a clear indication of disease.

Routine H & E staining procedures produce overstained mast cells in a cyst wall and obscure their true nature. This, plus their fusiform shape, may explain why mast cells have not been observed in helminth cysts before.

Several facts indicate that the cells described here as mast cells are not cells originating from the parasite tissue: 1) These cells showed the classic mast cell morphology, having definite differences from either basophils or eosinophils. 2) They demonstrated the tinctorial property of true metachromasia. 3) These cells were present in the host liver parenchyma, *i.e.*, on the host side of the cyst wall which presumably excludes cells of parasitic origin from entering host tissue. 4) The mast cell count of the infected liver was 10 times greater than normal, indicating an active proliferation and/or infiltration of mast cells. 5) The tissue of the encysted parasite

was devoid of any similar cell and displayed only slight metachromasia.

The appearance of mast cells in both of the cellular layers of the cyst of *H. taeniaeformis* indicates strongly that the entire cyst wall is of host origin. Since the mast cell is a connective tissue cell probably derived from undifferentiated mesenchymal cells, it is less likely that the cyst wall is elaborated from modified host-liver cells, although the latter may be involved in this reaction. Bogitsh(5), on the basis of histochemical tests, found a similar host-mesenchymal origin for the cyst wall of *Neoecchinorhynchus cylindratus* (a nematode parasite of fish) in liver.

The present demonstration of mast cells in the cyst wall contributes to the further identification of its cellular components. Moreover, it may provide an additional method of determining whether the cyst of a particular larval helminth is of dual host-parasite origin, or entirely produced by the host (Types I and II respectively, as described by Hunter and Dalton(6)).

Therefore, the function of the mast cell would appear, not unexpectedly, to include participation in some aspects of the host reaction to parasitic invasion.

Summary. Mast cells have been found in the cyst wall of a larval cestode parasite (*Hydatigena taeniaeformis*). The mast cells were present in the outer 2 layers of the cyst wall. This indicates that the entire cyst wall is of host-inflammatory origin and not derived from parasite tissue nor solely from modified host-liver cells. It is suggested that detection of mast cells as host-mesenchymal cellular units may aid in determining origins of cysts produced by other parasites.

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Quantitative Relation Between Certain Fibrinolysis Factors and Inflammation. (28068)

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This communication deals with the quantitation of the antiinflammatory activity of bovine and human fibrinolysin (plasmin) preparations. This effect described by Martin(1) and Copley and Tsuluca(2-7) represents a physiologically significant instance of the antiphlogistic action of proteolytic enzymes, since the activation of the profibrinolysin (plasminogen)-fibrinolysin system accompanies tissue injury(8).

Materials and methods. Male albino rats were anesthetized with sodium pentobarbital (35 mg/kg body weight), and their clipped abdominal skin injected at various sites with either the phlogogen alone or a mixture of phlogogen and fibrinolysin. The substances were injected in a volume of 0.02 ml, injection sites were rotated and no animal received twice the same dose of the antiinflammatory agent. Histamine dihydrochloride in

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