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GIANT CELL REACTION AGAINST THE LAMINATED MEMBRANE OF ECHINO- COCCUS CYSTS IN REINDEER LUNGS

By

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RONÉUS, OTTO: *Giant cell reaction against the laminated membrane of Echinococcus cysts in reindeer lungs.* Acta vet. scand. 1975, 16, 14—23. — In 23 pairs of lungs from reindeer two to five years of age, two types of hydatid cysts of *Echinococcus granulosus* were found: typical well-developed cysts and collapsed degenerated cysts.

Collapsed cysts were found in 13 pairs of lungs, well-developed in nine pairs, while both types of cysts were found in one pair of lungs.

A giant cell formation was present in the innermost zone of the surrounding adventitial membrane of both collapsed cysts and well-developed cysts. The giant cell reaction seemed to be induced by and directed against the laminated membrane. In the areas of the cysts where the laminated membrane showed a close contact with the adventitial membrane, the giant cells seemed to be actively engaged in the inflammatory process. On the contrary, in the areas of the cysts where the laminated membrane had lost contact with the adventitial membrane, the giant cells were degenerated or necrotic, and the space between the membranes was filled with necrotic cells. In cases where the laminated membrane had been pronouncedly disintegrated, the giant cells were also necrotic or nonexistent.

The giant cell reaction which was found even in comparatively young fertile cysts suggests that the reindeer variant of *E. granulosus*, if such exists, is not especially well-adapted to the reindeer as its intermediate host.

Echinococcosis; hydatidosis; Echinococcus granulosus; early degeneration; giant cell; laminated membrane; reindeer; lungs.

During a previous study on the prevalence of echinococcosis in Swedish reindeer (*Ronéus 1974*), a remarkable large number of hydatid cysts, which were collapsed, were found in the lungs of young animals. This prompted the present study, which shows

the relationship between the early developed inflammatory reaction dominated by giant cells and the early degeneration of hydatid cysts in reindeer lungs.

MATERIAL AND METHODS

Lungs from 1453 slaughtered normal reindeer were investigated. The reindeer originated from the arctic area of Sweden. The animals were young: two to five years old. The lungs were carefully palpated in order to detect even small or deeply located cysts. Hydatid cysts occurred in 23 cases.

The hydatid cysts and suspected lesions in the lung tissue were examined histologically. Neutral formaldehyde was used as fixative. Paraffine-embedded sections were stained with haematoxylin-eosin and periodic acid-Schiff (PAS) according to Hotchkiss, and after diastase preparation stained with PAS. For determination of lipids, formaldehyde-fixed frozen sections were stained with Sudan black.

RESULTS

The hydatid cysts from the lungs of the reindeer were of two different types: well-developed cysts and collapsed cysts. Among the 23 cases with hydatid cysts, nine cases had only well-developed cysts, 13 cases only collapsed cysts and a single case both types of cysts.

Well-developed hydatid cysts

Gross morphology. All these cysts were unilocular almost spherical and without daughter cysts, and the diameter ranged from 35 to 50 mm. Most of these cysts could be seen on the surface of the lungs (Fig. 1), but some were hidden in the tissue and were detected by palpation.

Histology. The well-developed hydatid cysts presented a typical picture. Most of them were fertile.

The germinal membrane contained brood capsules with scolices.

The laminated membrane was in all cases well developed and was situated close to the external adventitial membrane. The laminated membrane was strongly stained with PAS also after earlier preparation with diastase. With Sudan black it stained black.

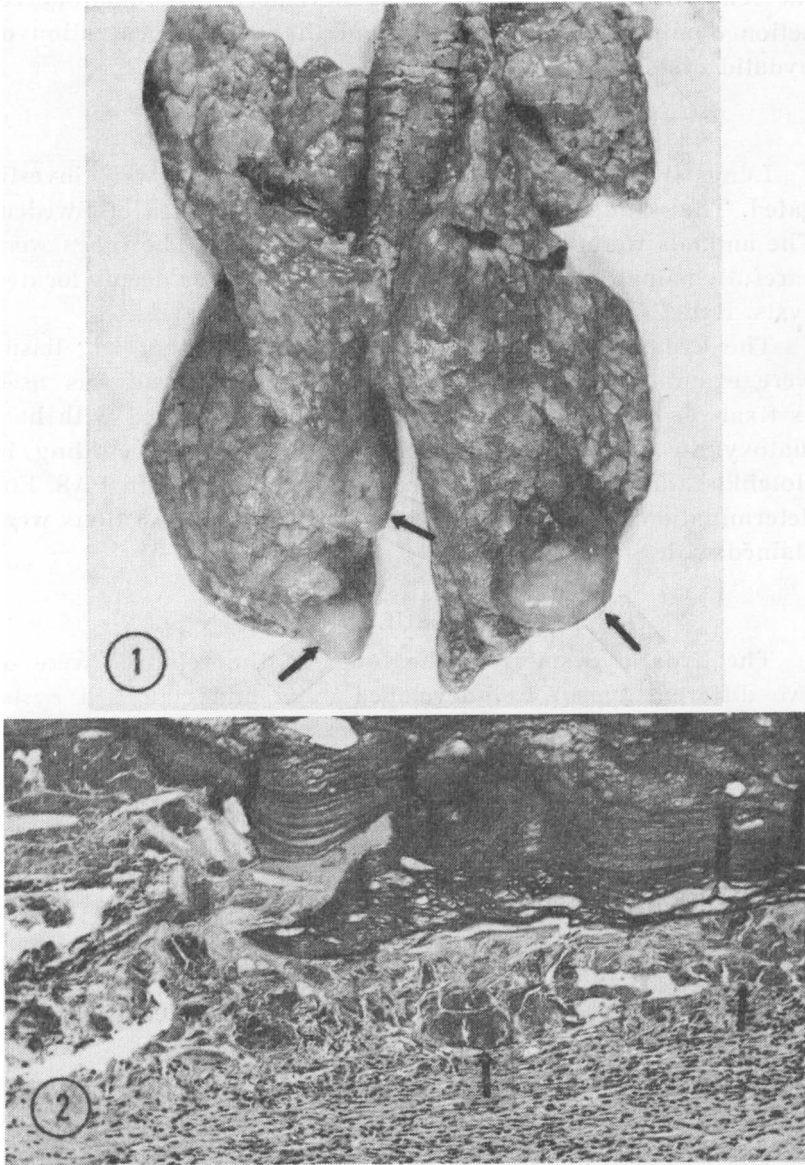


Figure 1. A pair of lungs from reindeer with three typical well-developed hydatid cysts. Two are seen on the surface of the lungs, the third one is only faintly outlined (upper arrow).

Figure 2. Part of a well-developed hydatid cyst from a lung of a reindeer. Above: the laminated membrane, which looks dark. Below: the adventitial membrane; the inner zone is composed of giant cells (arrows). The activity of the giant cells seems to be directed against the laminated membrane. PAS, $\times 150$.

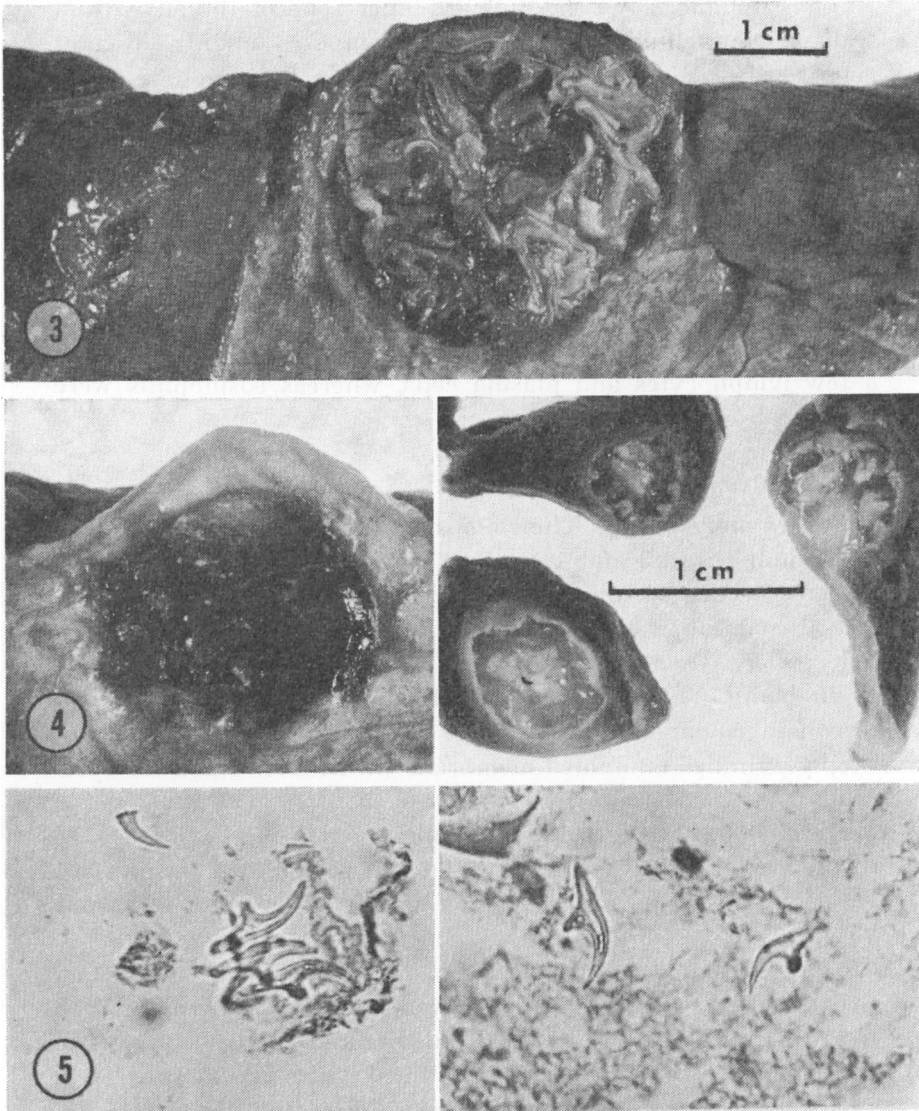


Figure 3. Section of a collapsed hydatid cyst in a reindeer lung. The cut surface of the cysts is variegated, due to the collapsed and deeply wrinkled laminated membrane.

Figure 4. Section of small collapsed hydatid cysts in reindeer lungs. The cysts are located within the tissue of the lungs.

Figure 5. Hooks from collapsed hydatid cysts. The hooks lie in groups or singly in the cyst. Eosin-haematoxylin, $\times 500$.

It is notable, however, that the inner zone of the adventitial wall of the well-developed cyst was composed mainly of giant cells (Fig. 2). The cells were arranged in palisade-like rows. The nuclei were, as a rule, located in those parts of the giant cell facing the adventitial membrane. The giant cells appeared to be highly active; their cytoplasm was filled with PAS-positive and diastase-resistant granules.

The granules in these giant cells gave with PAS, diastase-PAS, and Sudan black the same reaction as the laminated membrane.

The granulation tissue of the adventitial membrane contained a few lymphocytes and plasma cells, whereas eosinophils were seldom observed.

Collapsed hydatid cysts

Gross morphology. The collapsed cysts were, in all cases but one, small (Figs. 3 and 4), with a diameter of 5 to 10 mm. The larger cyst was 30 mm in diameter (Fig. 3). As a rule, the collapsed hydatid cysts were hidden in the lung tissue and were detected by palpation; only the largest one reached the surface of the lung. The cut surface of these cysts was usually dark brown in colour and was variegated, due to the collapsed and deeply wrinkled laminated membrane which often filled the cysts (Fig. 3).

Histology. The germinal membrane and the scolices were disintegrated in all collapsed cysts, but in most of the cysts a great number of loose hooks were found lying singly or in groups (Fig. 5).

The laminated membrane had, for the most part, lost contact with the surrounding adventitial wall and was pressed in deep irregular wrinkles towards the centre of the cysts (Fig. 6). The space between the membranes was filled with necrotic cells (Fig. 7). The laminated membrane showed different degrees of degeneration with lysis.

The adventitial membrane demarcated distinctly the hydatid cysts from the surrounding lung tissue. From the inner surface of the adventitial membrane papillae of connective tissue projected into the cysts (Fig. 8).

In the collapsed cysts giant cells were also present in the inner zone of the adventitial membrane. Their occurrence seems to depend partly on the degree of existing contact between the

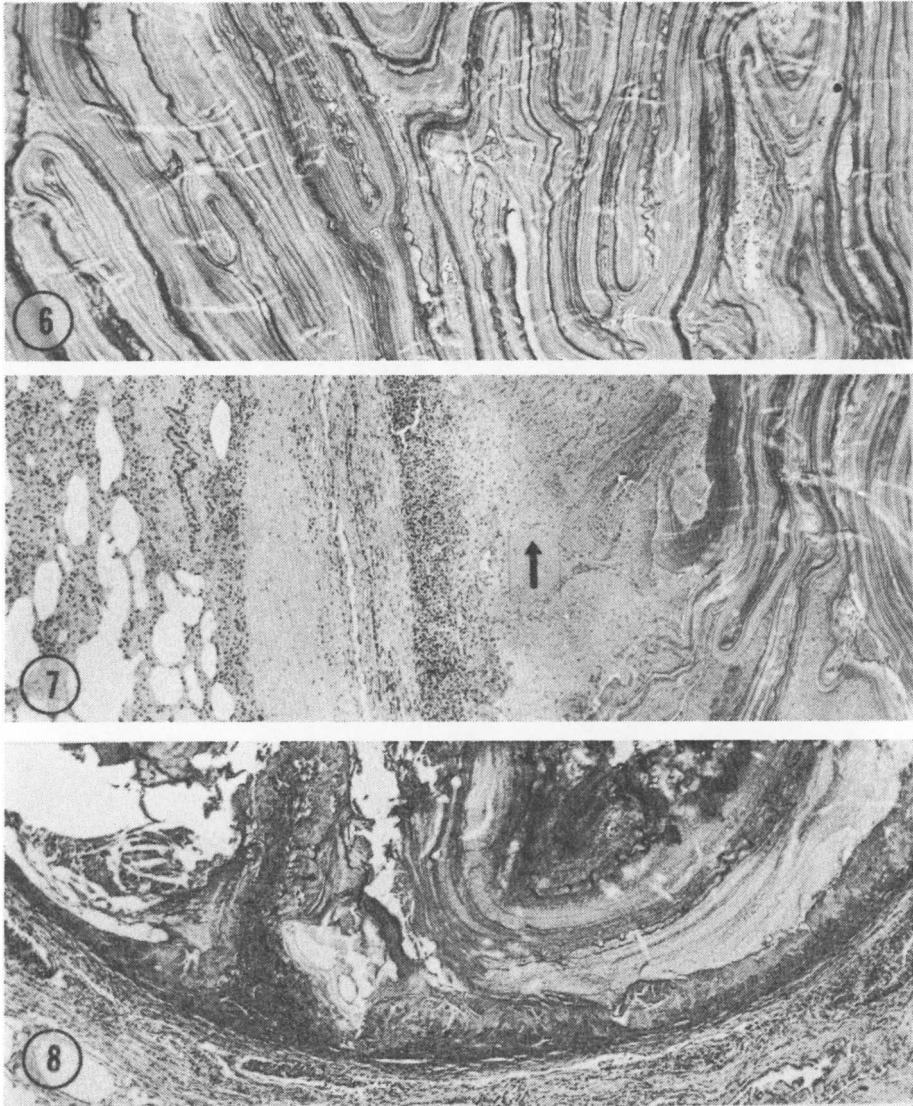


Figure 6. Laminated membrane in a collapsed hydatid cyst from a reindeer lung. The laminated membrane is irregularly and deeply wrinkled. PAS, $\times 50$.

Figure 7. Collapsed hydatid cyst. The laminated membrane has no contact with the surrounding adventitial membrane. The space in between (arrow) is filled with necrotic cells. PAS, $\times 50$.

Figure 8. Collapsed hydatid cysts from a reindeer lung. From the inner surface of the adventitial membrane a papilla of connective tissue projects into the cyst. PAS, $\times 50$.

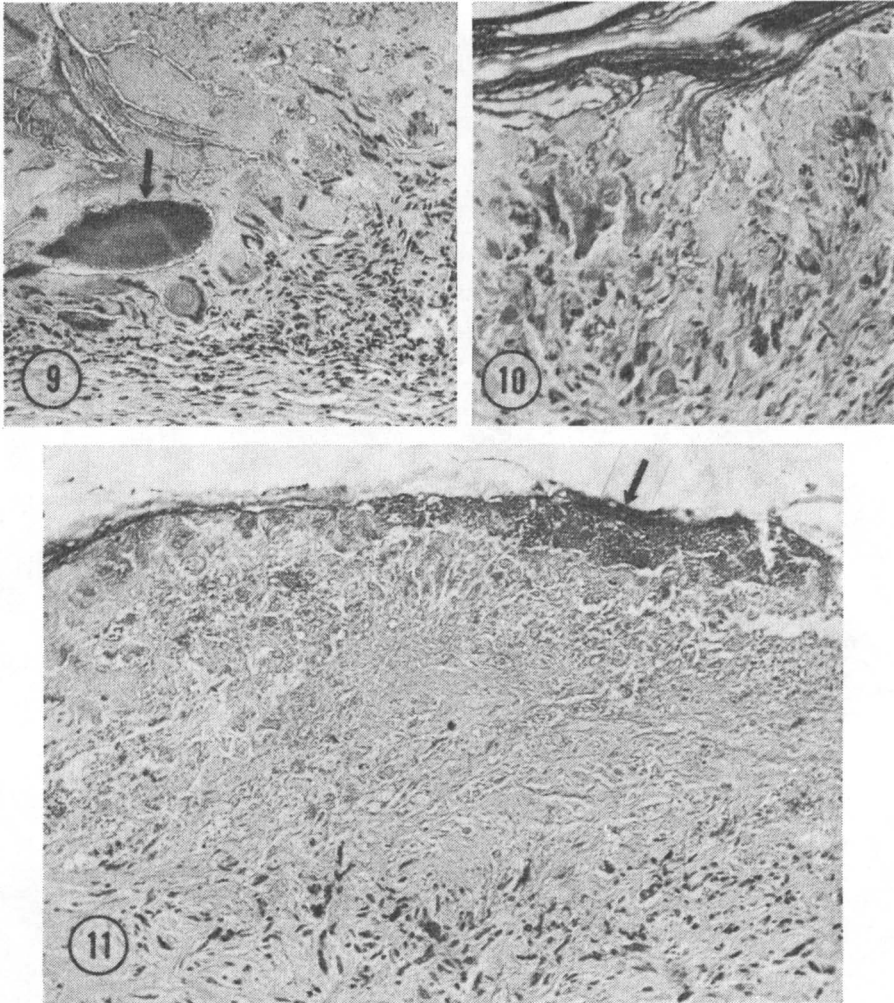


Figure 9. Collapsed hydatid cyst from the lung of a reindeer. Part of the laminated membrane, lying in contact with the adventitial membrane (arrow). The activity of the giant cells is directed against this part of the laminated membrane. To the right, where the laminated membrane has lost contact with the surrounding adventitial membrane, the giant cells are lytic. PAS, $\times 150$.

Figure 10. Collapsed hydatid cyst with a severe disintegration of the laminated membrane. The giant cells are to a large extent necrotic forming detritus. PAS, $\times 150$.

Figure 11. Wall of a collapsed hydatid cyst with more pronounced disintegration of the laminated membrane. Only fragments of this membrane are seen on the top of the cyst wall (arrow). The adventitial membrane is covered with necrotic cells, probably giant cells. PAS, $\times 150$.

adventitial and laminated membranes and partly on the degree of degeneration of the laminated membrane.

In cysts, the laminated membrane of which was only moderately degenerated but located in contact with the adventitial membrane, an accumulation of giant cells in the inner zone of the adventitial wall also occurred (Fig. 9). In areas of these cysts where the adventitial membrane had lost contact with the wrinkled laminated membrane the giant cells were lytic and the space was filled with detritus.

In cysts, the laminated membrane of which was severely degenerated, but still in contact with the adventitial membrane, the giant cells were also lytic or in the process of forming detritus (Fig. 10).

In cysts, the laminated membrane of which was to a large extent disintegrated so that only fragments remained, no recognizable giant cells were found. In these cases the inner zone of the adventitial membrane was covered with a necrotic mass (Fig. 11).

DISCUSSION

It is remarkable that of 23 cases of hydatid cysts in lungs of young reindeer, as many as 13 had only cysts of the collapsed type. These cysts were degenerated, but most of them contained hooks, indicating that the cysts had once been fertile with scolices, but had later on degenerated. Since the collapsed cysts as a rule were surrounded by lung tissue, they had apparently degenerated in an early stage before they had a chance to grow and reach the surface of the lung.

The inflammatory reaction against the hydatid cysts in the reindeer seems to be essentially of the same type as in other animals described by *Wetzel* (1970), but a noticeable strong giant cell reaction was present. The number of giant cells varied in different hydatid cysts, apparently depending on the stage of development of the cysts.

The reaction was most pronounced against fertile well-developed cysts. The development of giant cells seems to be induced by an intact or only moderately degenerated laminated membrane, and the activity of these cells seems to be directed against this membrane. The early degeneration and collapsing of the cysts seem to be correlated to the occurrence of the giant cells.

A severely degenerated laminated membrane, however, does

not seem to cause this stimulation of giant cell formation. In these cases, the giant cells seem, instead, to be degenerated or have disappeared.

The development of giant cells also seems to depend on the degree of existing close contact between the adventitial and laminated membranes. In cases where the wrinkled laminated membrane had lost contact with the adventitial membrane, the giant cells were also degenerated or had disappeared.

The occurrence of PAS-positive and diastase-resistant substances and of lipids in the intact or only moderately degenerated laminated membrane as well as in the contacting phagocytic giant cells indicates that these substances in the laminated membrane can be stimulating to giant cell formation. The ability of lipids to induce production of giant cells is stated by *Rich* (1951) and *Raffel* (1971).

The strong reaction can depend on the possibility that, in contrast to the common type of *E. granulosus* which prefers sheep and cattle as intermediate hosts, a variant of this worm occurs which prefers reindeer. Such a presumed reindeer variant has been given the name *Echinococcus granulosus* var. *canadensis* (*Cameron & Choquette* 1963). The biological composition of the laminated membrane of such a reindeer variant could possibly be stimulating to a more pronounced and early giant cell formation.

The occurrence of a special immunological mechanism of the hydatid cysts of a reindeer variant causing this early and strong giant cell reaction cannot be neglected.

The early degeneration of a great number of hydatid cysts in lungs of young reindeers seems difficult to explain but can indicate that the hydatid cysts are not especially well-adapted to reindeer as the intermediate host.

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SAMMANFATTNING

Jättecellsreaktion mot den lamellerade membranen i Echinococc-cystor från renlungor.

I 23 lungpar från 2—5 år gamla renar påvisades två typer av hydatidcystor till *Echinococcus granulosus*: typiska välutvecklade cystor och kollaberade degenererade cystor.

Kollaberade cystor fanns i 13 lungpar, välutvecklade i 9 och båda typerna av cystor i ett lungpar.

En jättecellsreaktion förekom i innersta zonen av den omgivande adventitia membranen såväl i kollaberade som i välutvecklade cystor. Jättecellsreaktionen synes vara inducerad av och riktad mot den lamellerade membranen. I områden där den lamellerade membranen låg i nära kontakt med adventitia membranen syntes jättecellerna vara aktivt engagerade i den inflammatoriska processen. I områden där den lamellerade membranen hade mist kontakten med den omgivande adventitia membranen var däremot jättecellerna degenererade eller nekrotiska och spalten mellan membranen fylld med nekrotiska celler. I de fall där den lamellerade membranen hade blivit högggradigt upplöst var även jättecellerna nekrotiska eller saknades de helt.

Den förekommande jättecellsreaktionen, även mot tämligen unga fertila cystor, talar för att renvarianten av *E. granulosus*, om en sådan existerar, ej är särskilt väl adapterad till renen som sin mellanvärd.

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