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LEUKAEMIC NEOPLASIA IN FREE-LIVING MAMMALS IN DENMARK

By

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ELVESTAD, KARI and ULRIK V. HENRIQUES: *Leukaemic neoplasia in free-living mammals in Denmark.* Acta vet. scand. 1985, *26*, 61—71. — In a material of free-living mammals collected and necropsied during the period 1934——1984, leukaemic neoplasia was found in 1 roe deer, 1 red deer and 15 brown hares. In order to determine the types of leukaemia, a histological reexamination of the tissues was performed. The two deer had the same type, while 4 different types were found in the hares. There was no evidence suggesting a contagious nature of the neoplasia or an accumulation of cases within certain geographic areas.

wildlife; leukaemia; roe deer; red deer; brown hare.

Leukaemic neoplasia is not uncommon among free-living mammals. In Sweden, leukaemia is found in elk (Alces alces) and roe deer (Capreolus capreolus) (*Hansen & Borg* 1965), and in snow hare (Lepus timidus) and brown hare (Lepus europeus) (*Mörner & Borg* 1984). In Germany it is found in red deer (Cervus elaphus), roe deer, and brown hare (*Weidlich* 1959, *Piening & Wermerssen* 1965). Leukaemic cases in brown hares from Switzerland (*Burgisser* 1957) and France (*Guillon* 1963) are also reported. In England, leukaemia is seen in fallow deer (Dama dama), red deer, and roe deer (*Jennings* 1968). In the U.S.A. leukaemia is found in whitetailed deer (Odocoilus virgianus) (*Debbie & Friend* 1967) and in cottontail rabbit (Silvilagus floridanus mearnsii) (*Lopushinsky & Fay* 1967).

MATERIALS AND METHODS

In Denmark, free-living birds and mammals found dead or killed in a moribund condition have since 1934 been necropsied

at the Section for Wildlife Diseases, State Veterinary Serum Laboratory, Copenhagen. The present survey, which is based on that material, aims at elucidating the occurrence of leukaemic neoplasia in free-living mammals. A scrutiny of all records of necropsies on mammals revealed that leukaemia had been found in roe deer, red deer and brown hares. Tissues from the animals in question have now been reexamined histologically in order to differentiate the leukaemic tumors in accordance with the classification system for tumors in domestic animals given by the WHO (*Jarret & Mackey* 1974). The formalin-fixed tissues were embedded in paraffin, and sections were cut and stained with hematoxylin-eosin and with Giemsa's stain (*Henriques* 1970). The age of the deer was judged from the state of their teeth and that of the hares from the development of their genitals.

RESULTS

Table 1 gives the total number of roe deer, red deer and brown hares examined since 1934, and the frequency of tumors and leukaemia in this material. The chronological and geographical distribution of the leukaemic animals is shown in Fig. 1.

Table 1. The occurrence of neoplasia in roe deer (Capreolus capreolus), red deer (Cervus elaphus) and brown hare (Lepus europeus) in a Danish necropsy material collected during the period 1934—1984.

	No. of animals examined				
	Total	With tumors	in %	With leukaemia	%
Roe deer	1869	62	3.3	1	0.01
Red deer	138	4	2.4	1	0.72
Brown hare	8572	38	0.42	15	0.16

The roe deer was an emaciated one-year-old male, found in a poor condition and shot. At post mortem it was found to be heavily infested with intestinal nematodes. It originated from a military training area, Borris Hede, Skjern, in which biological surveys of the roe deer population had been carried on since 1973. In 1977, the population was estimated at 1300 animals, while in 1980 it had decreased to 500 because of overstocking. From the same area 22 other roe deer, and internal organs from a further 9, have been received for examination. Besides, the biologists and the game keepers working at the place since 1978 have been

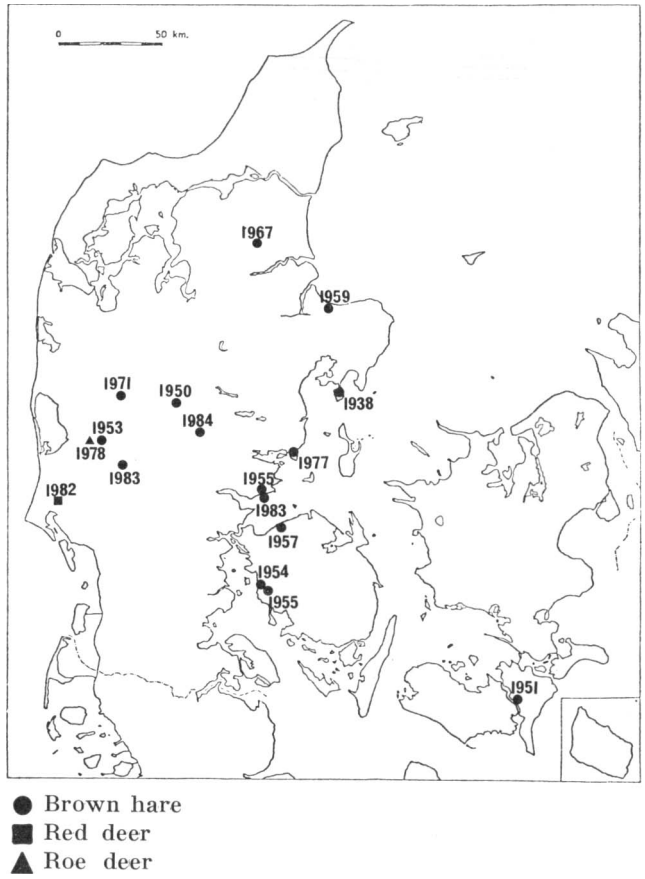

Figure 1. The geographic and chronological distribution of leukaemic roe deer, red deer, and brown hares in Denmark.

instructed to examine shot roe deer for abnormalities in lymph nodes and organs, and as a result a roe deer has been found with carcinoma of the liver.

The red deer was an emaciated female of more than 10 years old, which had also been shot when observed weak. It came from a military training area at Oksbøl, and after the game keepers have been instructed as at Borris, a red deer with extensive liver-cell hyperplasia has been found.

Of the 15 hares with leukaemia 2 were juvenile. There were 7 males and 8 females, all in a state of nutrition below normal. All the hares seemed to have died or been dying of the leukaemia, except perhaps for 1 juvenile hare which in addition to the

leukaemia had chronic sinusitis, chronic pyelonephritis, and strongylosis.

Generally, necropsy of the animals showed enlargement of several lymph nodes and of the spleen, and in half the cases also of the liver. In most of the cases lymphoid cell infiltrations were found in various organs on histological examination. No specific necropsy picture could be related to the various types of leukaemia.

Table 2. Histological classification of leukaemic neoplasias.

Species	Time of death	Sex	Age	Histological diagnosis
Roe deer	May 78	M	1 yr.	Lymphoid leukaemia, poorly diff.
Red deer	May 82	F	>10 yrs.	Lymphoid leukaemia, poorly diff.
Brown hare	Jan 38	M	ad.	Lymphosarcoma, lymphocytic, aliment.
	Apr 50	F	ad.	Lymphoid leukaemia, poorly diff.
	May 51	F	ad.	Lymphosarcoma, poorly diff., thymic
	Mar 53	M	ad.	Lymphoid leukaemia, poorly diff.
	May 54	F	ad.	Myeloid leukaemia
	May 55	F	ad.	Erythroleukaemia
	Nov 55	F	ad.	Lymphosarcoma, poorly diff., alimentary
	Jun 57	M	ad.	Lymphosarcoma, localization?, poorly diff.
	Oct 59	M	ad.	Lymphosarcoma, localization?, poorly diff.
	Jul 67	F	?	Leukaemia *
	Feb 71	M	ad.	Lymphosarcoma, lymphoblastic, thymic
	Feb 77	M	ad.	Lymphoid leukaemia, poorly diff.
	Nov 83	M	ju.	Lymphosarcoma, poorly diff., kidney
	Dec 83	M	ju.	Lymphoid leukaemia? (poorly diff.? lymphoblastic)
	Mar 84	F	ad.	Lymphoid leukaemia, prolymphocytic

M = Male.
F = Female.
ad. = More than one year.
ju. = Less than one year.
* No slide available, diagnosis as originally recorded.

Table 2 shows the histological classification of the leukaemic tumors. Lymphoid leukaemia was found in the roe deer, the red deer and in 5 hares. Lymphosarcomas (Figs. 2, 3, 4, and 5) with different localizations were found in 7 hares, while 1 hare had myeloid leukaemia (Figs. 6 and 7) and 1 had erythroleukaemia (Figs. 8 and 9). For 1 hare it was not possible to determine the type of leukaemia.

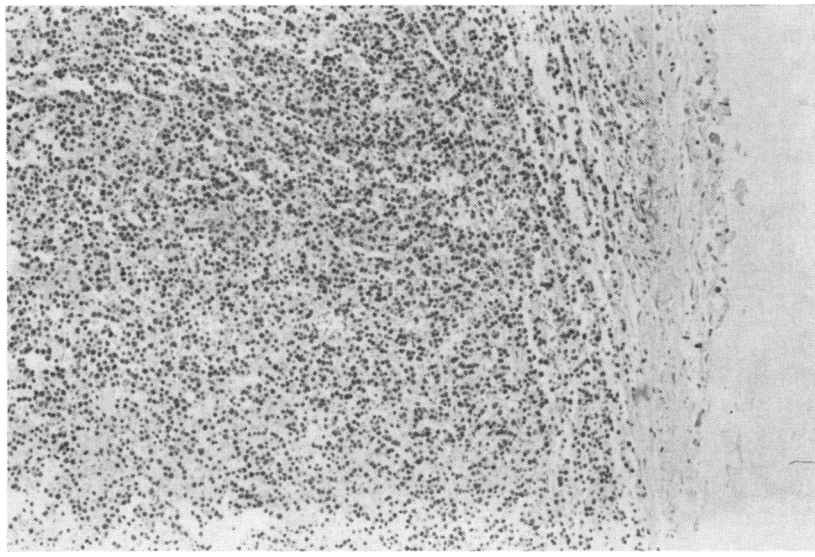

Figure 2. Lymphosarcoma, poorly differentiated. Architecture destroyed. Penetration of capsule. Obj. × 10.

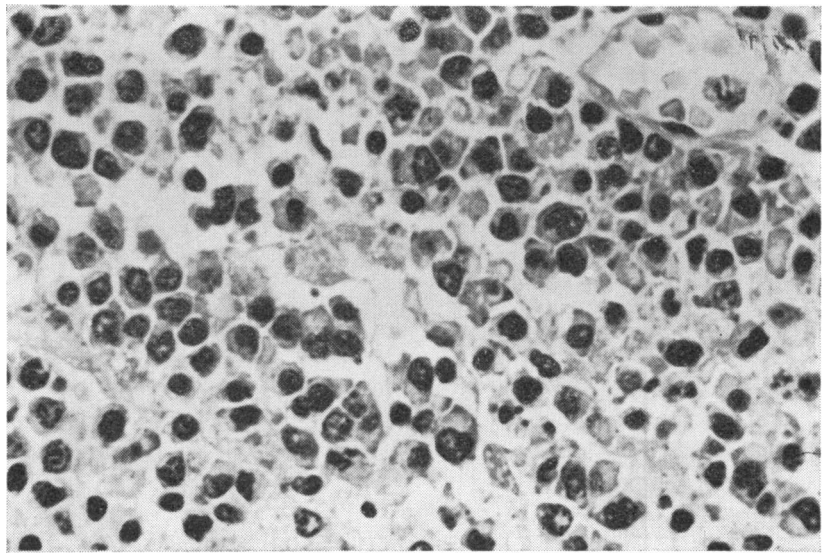

Figure 3. Lymphosarcoma, poorly differentiated. Large immature cells with ample cytoplasm. Obj. × 63. (Same case as Fig. 2).

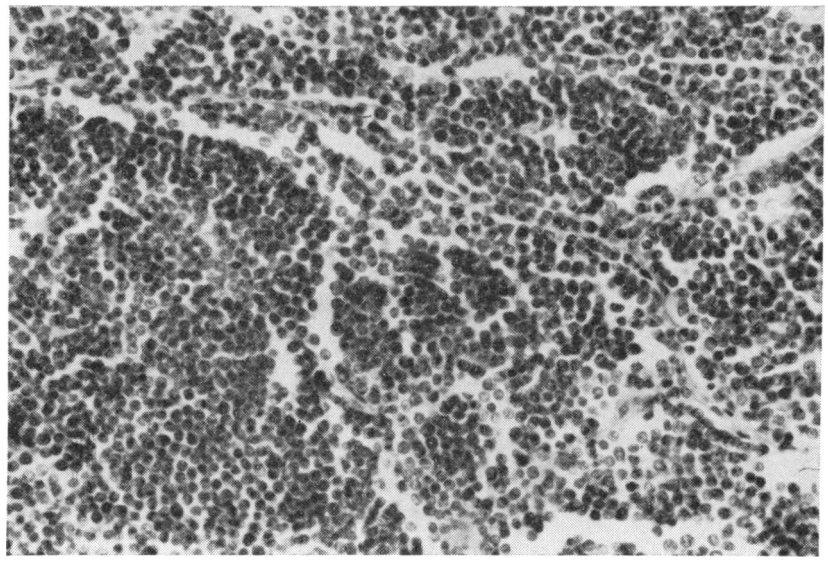

Figure 4. Lymphosarcoma, lymphocytic architecture destroyed. Obj. × 10.

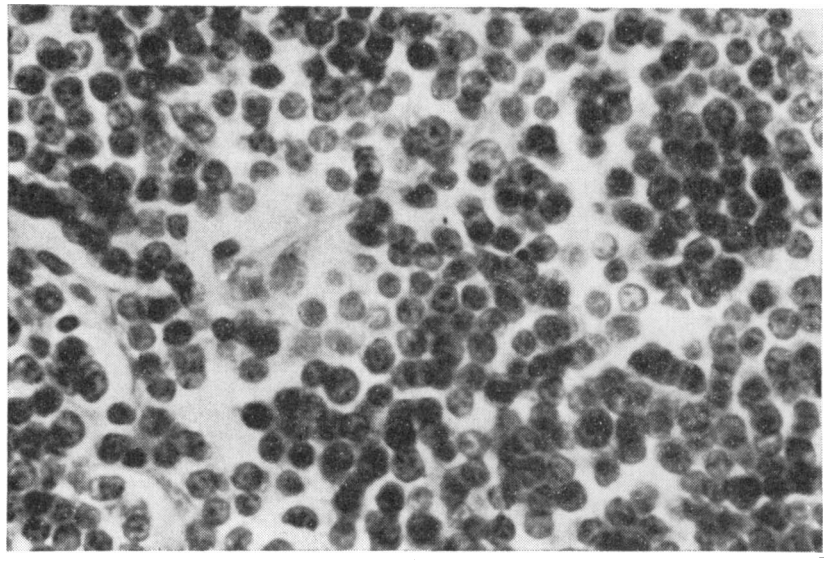

Figure 5. Lymphosarcoma, lymphocytic. Small uniform cells. Obj. × 63. (Same case as Fig. 4).

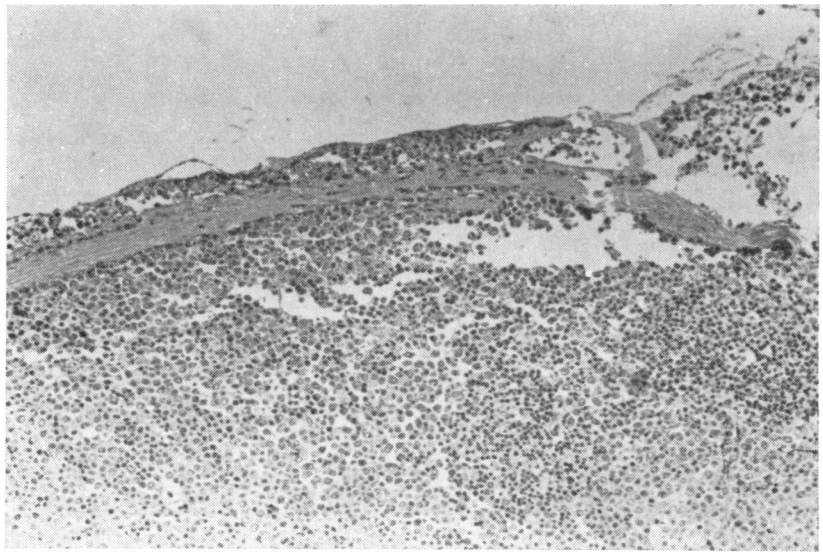

Figure 6. Myeloid leukaemia. Lymphnode architecture blurred by infiltrate penetrating capsule. Obj. × 10.

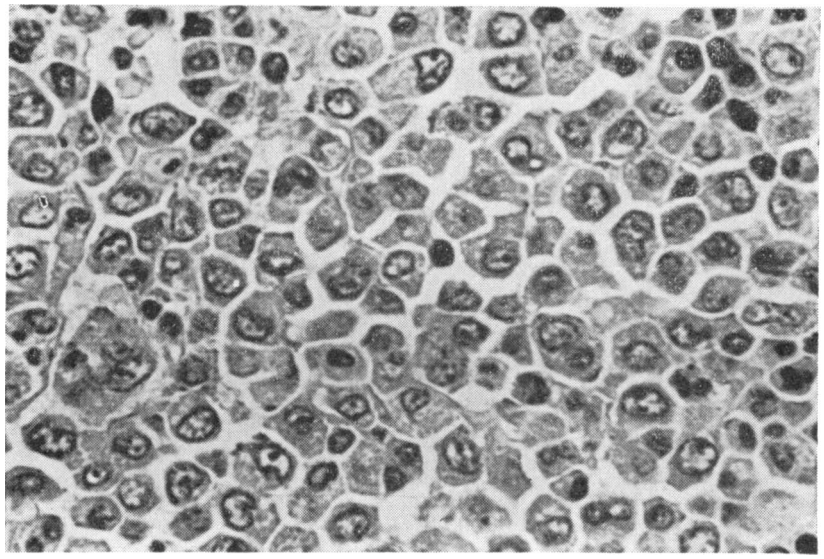

Figure 7. Myeloid leukaemia. Immature myeloid cells. Obj. × 63. (Same case as Fig. 6).

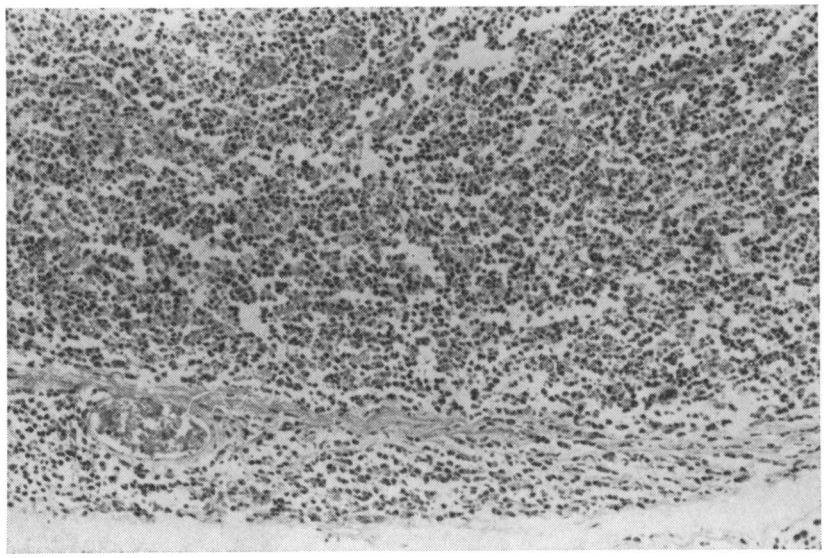

Figure 8. Erythroleukaemia. Lymphnode architecture blurrer by infiltrate penetrating capsule. Obj. × 10.

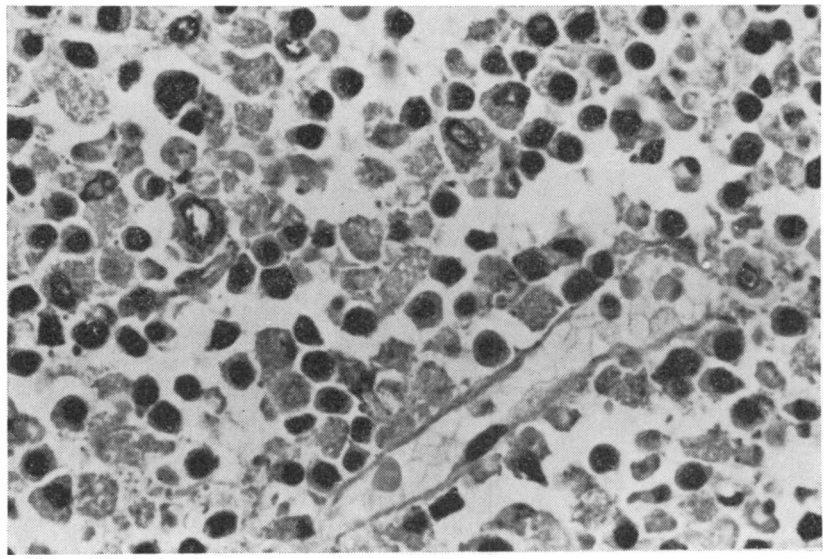

Figure 9. Erythroleukaemia. Immature myeloid and erythroid cells. Obj. × 63. (Same case as Fig. 8).

DISCUSSION

The histological differentiation of true lymphoid leukaemia from lymphosarcoma with leukaemic development is difficult and, when hemopoietic marrow is not available and the diagnosis has to be made from only a few selected slides, in many cases somewhat arbitrary. In the present communication the term lymphosarcoma has been used in connection with localized, fairly well delimited lesions, whereas more diffuse lesions and cellular infiltrations in otherwise well preserved organs have been termed leukaemia.

Modern immunohistochemistry and electron microscopy have contributed to a more precise classification of hemopoietic neoplasms than that provided by the WHO veterinary classification of 1974. The latter, however, is based on conventional histology applicable to a retrospective study. It furthermore enjoys international recognition. Taking into consideration the viral etiology of many lymphoid neoplastic proliferations, a separation in the present study of these from corresponding proliferations of the hemopoietic the system and from non-hemopoietic tumors was found to be the major task. For this the WHO classification is well suited, and therefore, and because of the above-mentioned advantages, it was chosen.

The WHO classification is based on 3 main groups: Lymphoid and myeloid neoplasms, and mast cell tumors. In the present survey only cases belonging to the two first groups were found. From the category of lymphoid neoplasms, lymphosarcomas and lymphoid leukaemia were represented in the material. The lymphosarcomas are described by their anatomical localization and by the cell types. In lymphoid leukaemia localized tumors are not a feture, and various cytological types are described. In the group of myeloid neoplasms myeloid leukaemia and erythroleukaemia were found. Myeloid leukaemia consists of myeloid cells while in erythroleukaemia myeloid as well as erythroid cells are seen.

The frequency of leukaemia in roe deer in the present material (0.01 %) seems to be lower than in similar material from Sweden, where 0.22 % of 1862 roe deer (and organs) sent in for necropsy were found to have leukaemia. The types described are lymphocytic leukosis and histiocytic leukosis (*Hansen & Borg* 1965). The population of roe deer is well monitored for diseases and there seems to be no evidence that leukaemia in deer is con-

tagious. The type of leukaemia found in deer is known also in cattle, though rarely seen (*Moulton & Dungworth* 1978). While the prevalence of leukaemia in cattle in Denmark since the 1950'ies has been highest in Sjælland, Lolland and Falster (*Bendixen* 1957), wildlife leukaemia has mostly been found in Jutland (Fig. 1). There is, therefore, no reason to suspect an etiological relationship between the two conditions.

Whether the frequency of leukaemia in hares is higher or lower in Denmark than in other countries cannot be told, since no surveys like the present one seem to have been made elsewhere. Lymphoid leukaemia as well as myeloid leukaemia is found among hares in Sweden (*Mörner & Borg* 1984) and malignant lymphoma is found in cottontail rabbits in the U.S.A. (*Lopushinsky & Fay* 1967). Erythroleukaemia is rare among domestic animals; it is seen most commonly in cats (*Schalm et al.* 1975).

From Table 2 it is seen that hares with leukaemia were found rather frequently in the years 1950—58. In this period the number of hares sent in for necropsy was high, owing to an epidemic of pseudotuberculosis. In the years 1982—84 there has also been an increased mortality among the hares, resulting in great numbers of hares — particularly juveniles — being sent in for necropsy. So far the causes of this increased mortality have not been found. However, among the hares received there were 2 with leukaemia.

Two hares with leukaemic neoplasia originated from the same locality, but the findings were 28 years apart, and the 2 cases were of different leukaemic types.

From the present survey there seems to be no indication that leukaemic neoplasia among hares in Denmark is induced by an infectious agent, or associated with certain geographic localities.

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SAMMENDRAG

Leukæmi hos vildtlevende pattedyr i Danmark.

Et obduktionsmateriale bestående af fritlevende pattedyr i perioden 1934—1984, er blevet gennemgået med henblik på forekokmst af leukæmi. Leukæmisk neoplasi blev fundet hos rådyr, krondyr og harer. Blandt 1869 rådyr havde 0,01 % leukæmisk neoplasi, hos 138 krondyr var der 0,72 % og hos harerne fandtes der leukæmisk neoplasi hos 0,16 % af 8572 dyr. For at kunne skelne mellem de forekommende typer blev der foretaget en histologisk reevaluering. Herved fandtes 4 forskellige typer. Lymfoid leukæmi sås hos rådyret, krondyret og 5 harer. Lymfosarcomer fandtes hos 7 harer, 1 hare havde myeloid leukæmi og 1 erytroleukæmi. Frekvensen af lymfoid neoplasi i rådyr i dette materiale er lavere end den procent (0,22) man har fundet blandt 1862 rådyr i Sverige. Det vides ikke, om frekvensen af leukæmi blandt harerne er højere eller lavere end i andre lande.

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