SEASONAL VARIATION IN THE BLOOD LEUKOCYTE COUNT IN DOGS

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The blood leukocyte count was investigated for a period of 7 years in healthy dogs leading an outdoor life. The number of lymphocytes and eosinophils was higher in May through September than in November through March. Variations in the numbers of neutrophils and monocytes obeyed the opposite rule. Changes in the total leukocyte count did not coincide with the seasonal rhythm.
KEY WORDS: leukocytes; seasonal variation.

Seasonal variation is one of the fundamental properties of living organisms that ensure the maintenance of homeostasis. The leading role in the operation of the body's biological clock is played by endocrine mechanisms (especially the function of the pituitary-adrenocortical system), which are receptive of exogenous rhythms through the CNS and bring the endogenous rhythms into optimal relations with them. The blood system is under the clear influence of seasonal factors [5], as has been shown mainly in natural populations of rodents [2]. This problem has not been studied in laboratory animals on a large enough scale.

The blood leukocyte count of healthy dogs was investigated over a period of 7 years.

EXPERIMENTAL METHOD

The observations began in January, 1967, on 18 male dogs then weighing 10-15 kg and aged from 1 to 3 years. The animals were kept on a lead in the open air throughout the year. Twelve females, kept for 3 years under the same conditions, also were investigated. All dogs received a normal diet. The blood tests were carried out by the usual methods. Investigations were made every 2 months in January, March, May, July, September, and November of each year. These times were pooled into two periods to correspond to the two phases of the change in number of lymphocytes and neutrophils observed. One of these periods (May-September)

TABLE 1. Blood Leukocyte Count in Dogs (pooled data for 7 years of observations)

Index	All cold seasons		All hot seasons		Total for 7 years		Comparison of seasons	
	n	$M \pm m$	n	$M \pm m$	n	$M \pm m$	t	P
Absolute number of cells, thousands/mm³								
all leukocytes	268	8,53±0,11	244	8,32±0,10	512	8,41±0,07	1,40	>0,05
neutrophils	261	5,32±0,09	228	6,98±0,09	489	5,17±0,07	2,68	<0,01
lymphocytes	261	1,80±0,03	228	2,19±0,05	489	1,99±0,03	7,80	<0,001
eosinophils	226	0,376±0,016	177	0,433±0,018	403	0,401±0,012	3,27	<0,05
monocytes	261	0,541±0,017	228	0,453±0,013	489	0,497±0,011	5,00	<0,001
Relative number of cells, %								
neutrophils	261	64,79±0,54	228	60,35±0,56	489	62,72±0,38	5,70	<0,001
lymphocytes	261	21,98±0,43	228	27,01±0,47	489	24,36±0,32	7,85	<0,001
eosinophils	261	6,17±0,19	228	6,76±0,21	489	6,45±0,13	2,11	<0,05
monocytes	261	6,41±0,17	228	5,53±0,14	489	5,99±0,11	4,00	<0,001

Legend: n) number of tests.

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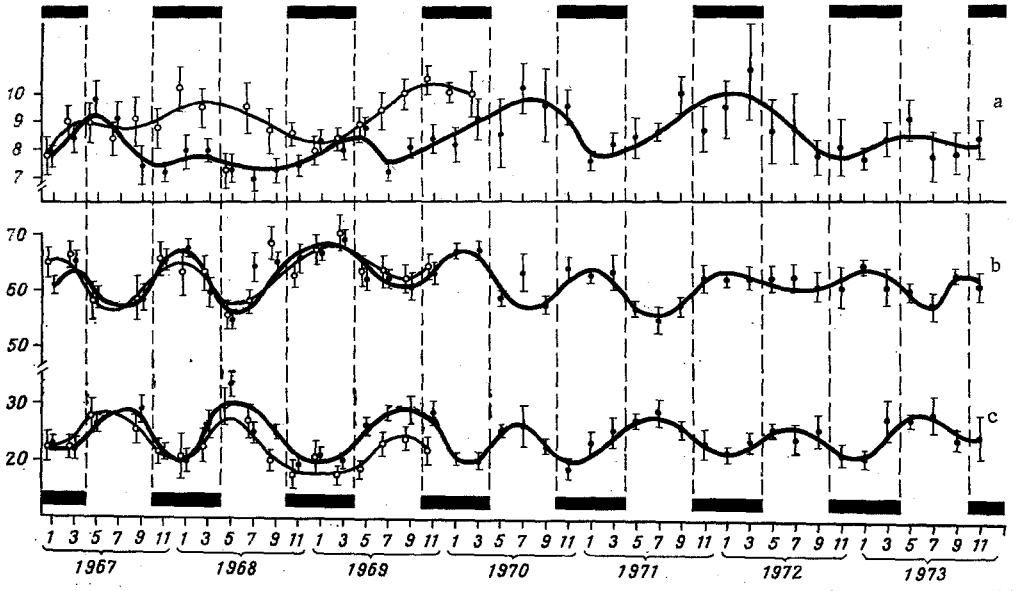

Fig. 1. Changes in total leukocyte count (a) and relative numbers of neutrophils (b) and lymphocytes (c) over a 7-year period (M ± m). Abscissa, calendar months and years; ordinate, number of cells (a – in thousands/mm^3, b, c – in %). Filled circles represent data for males, empty circles for females. Vertical broken lines mark boundaries between periods, cold periods being identified by thick horizontal lines.

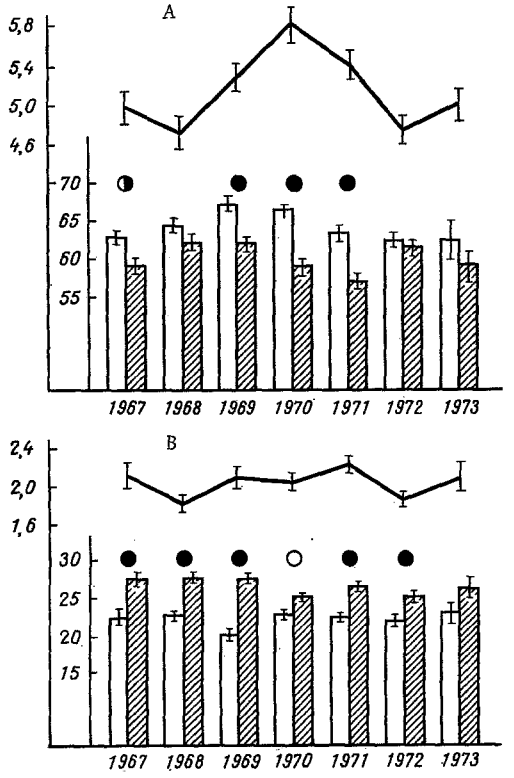

Fig. 2. Averaged neutrophil (A) and lymphocyte (B) counts for years (curves) and for periods of year (columns). Abscissa, calendar years; ordinate, number of cells (curves – in thousands/mm^3, columns – in %). Unshaded columns represent cold season, shaded columns hot season. Circles show degree of significance of differences between seasons: white – $P < 0.05$, while and black – $P < 0.01$, black – $P < 0.001$.

was described as the hot, the other (November-March) as the cold season of the year. The ordinary parameters were used for statistical analysis of the results and comparison was by Student's t test.

EXPERIMENTAL RESULTS

Variations in the total number of leukocytes did not correspond exactly to the changes of the seasons of the year (Fig. 1a) and with respect to this parameter no differences were found between the seasons even when

data for all the hot and all the cold periods of the 7 years of the observations were averaged (Table 1). The relative number of neutrophils and, in particular, of lymphocytes, while remaining within normal physiological limits, did vary in accordance with the season of the year (Fig. 1b, c). The lymphocyte count rose in the hot period and fell in the cold, whereas the neutrophil count varied in the opposite direction. A similar pattern also was observed in the females (Fig. 1, thin lines).

Changes in the absolute numbers of lymphocytes and neutrophils averaged for the seasons and, for the years disregarding the seasons, are shown in Fig. 2. Despite relatively constant mean annual values for the lymphocyte count and considerable variations in the neutrophil counts from year to year, differences between the seasons could be detected for both types of leukocytes during all the 7 years, and in most cases they were statistically significant. Variations in the numbers of monocytes and eosinophils showed a less clear dependence on the change of seasons, the reason evidently being the relatively small number of these types of cells and the consequent difficulty of detecting seasonal changes. On averaging the results obtained for all hot and all cold periods, significant differences were found between the seasons for these types of leukocytes also (Table 1). The eosinophil count showed changes parallel to the lymphocyte count, and the monocyte count changed parallel with neutrophil count.

The parallel character of changes in the lymphocyte and eosinophil counts suggests that the changes in the blood leukocyte count described above are determined by the appropriate rhythmic activity of the adrenal cortex. However, comparison of the results of these observations with seasonal changes in adrenocortical activity studied in dogs by Kraso [3] revealed no direct link. The lymphocyte and eosinophil counts were raised at a time (May, July, September) when, as Kraso found, the production of glucocorticoids, which give a lymphocytopenic and eosinophilopenic effect, is increased. A similar phenomenon was observed by Golikov [1] in experiments on rats, in which the blood lymphocyte count and corticosteroid production were both increased in the spring and summer period. The relationship between seasonal changes in the blood cell composition and the function of the regulatory systems of the body bringing about these changes is evidently not a simple, direct type.

Seasonal changes in the blood leukocyte count are also observed in man, but in this case they are opposite in direction to those found in dogs [4]. The physiological significance of the seasonal changes described above is not yet clear. They may perhaps merely reflect other adaptive reactions and be themselves of no great importance to the body. However, in experimental work the possibility of seasonal rhythms must be taken into account not only to avoid mistakes in the interpretation of the results, but also as a test to enable the state of the regulatory systems of the organism to be assessed.

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