Veterinary Microbiology, 1 (1976) 327–336
Elsevier Scientific Publishing Company, Amsterdam – Printed in The Netherlands

The influence of colostrum and milk on the development of lymphocytosis in the bovine

O. C. Straub and R. J. Lorenz
Federal Research Institute for Animal Virus Diseases, P. O. Box 1149, 7400 Tübingen, Federal Republic of Germany

Abstract

The development of lymphocytosis in 2 groups of cattle derived from leukotic dams and a third group of cattle derived from normal dams was studied over a period of several years. One group was raised colostrum-deprived; a second received colostrum and milk for several months; the third group served as controls. The colostrum did not appear to influence the development of the lymphocytosis. Three different patterns of development of lymphocytosis were, however, apparent.

One type did not show any lymphocytosis and resembled therefore the control group (10/38 calves), the second type was characterized by a slowly developing lymphocytosis (13/38 calves) and the third one showed an explosive type of rapidly developing lymphocytosis (15/38 calves). No correlation could be shown with simple genetic or environmental factors. Several questions were raised which merit further research.

Introduction

Earlier experiments have shown that lymphosarcoma is often preceded by a lymphocytosis (Straub, 1968). This increase in circulating lymphocytes has been widely used for diagnostic purposes. It has also been demonstrated that transmission of the disease can occur vertically, i.e. from dam to offspring, as well as by feeding colostrum and milk from diseased animals

(Straub, 1968 and 1969). Since colostrum and milk contain antibodies as well as the antigen, an experiment was set up to investigate whether or not feeding colostrum and milk to offspring from diseased dams would enhance the development of lymphocytosis.

Material and Methods

The calves were the progeny of 26 leukemic cows, all of which had a high lymphocyte count at parturition or when cesarean section was performed. The cows had originally been obtained from 10 multiple-case herds (enzootic bovine leukosis, adult multicentric type) from different parts of the country and were mostly of the Holstein-Friesian breed. The majority has since died of lymphosarcoma.

For this study 56 calves were divided into three groups: (1) 18 calves taken by cesarean section and raised without colostrum or milk from their dams, (2) 20 calves fed colostrum and milk from their dams or other highly leukemic cows for at least 3 months, (3) 18 calves which served as a control group These last were born of nonleukotic dams and raised on their colostrum and milk. The calves of the leukotic dams were raised and kept in isolation units in groups of up to 4. The white blood cell and differential counts were made at least once a month.

Results and Discussion

On average, the lymphocyte counts decreased in the control group with increasing age, in the usual manner (Lorenz and Straub, 1976). The lymphocyte counts of groups 1 and 2 rose significantly during the first 3 years, reaching a plateau of about 11,000 lymphocytes. The individual curves, however, showed considerable variation about the mean values of the group, ranging from 5,000 to 26,000 lymphocytes. Details may be seen in the figures:

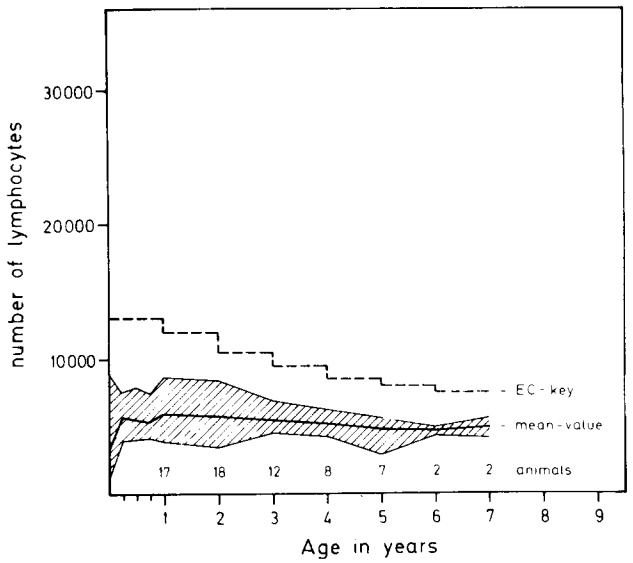

Fig. 1. Mean values and distribution of lymphocyte counts in controls (from nonleukotic dams)

In Fig. 1 the lymphocyte counts of group 3, the controls, are shown. The values are far below the lower positive limit of the leukosis keys (Lorenz and Straub, 1976). For demonstration, in order to avoid the enormous scatter of the individual monthly observations, the mean values of three adjoining months at the end of each year were used, except for the first year. Even maximum values were below 10 000 lymphocytes.

In Fig. 2 the mean values and distribution of lymphocyte counts from animals of group 1 (raised without colostrum and milk) are given. The scatter is wide. This does not, however, mean that the lymphocyte counts of the individuals are scattered over the whole range. It could indicate the existence of individuals with permanently low or high lymphocyte counts. That is to say, the whole area is covered by the curves of individual animals, whereas each of them may have only a relatively small scatter compared to the total scatter. By the age of two the average lymphocyte counts had already reached a stage which is positive according to the leukosis key. A comparison with Fig. 1 shows already during the second year the marked difference between groups 1 and 3.

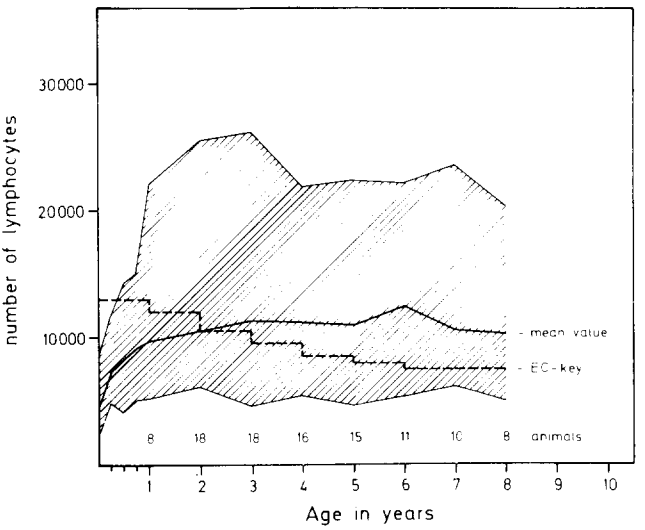

Fig. 2. Mean values and distribution of lymphocyte counts in colostrum-deprived calves from leukotic dams (group 1)

The values obtained from the animals in group 2 (fed with colostrum and milk from their leukotic dams) during the first 2 years already exceed those of group 1; but statistical analysis demonstrates that these differences are not significant. Details may be seen in Fig. 3.

The development of lymphocytosis in the individual was also studied, resulting in classification into three different types:

1 (WL) : animals without any lymphocytosis
2 (SDL) : animals with a slowly developing lymphocytosis
3 (RDL) : animals with a rapidly developing lymphocytosis

Examples of those types are given in Fig. 5. The WL type was found in animals from normal nonleukotic dams, which could remain aleukemic throughout their life and yet still develop lymphosarcoma (Albrecht, et al., 1974). Type 2 (SDL) did not pass the leukosis key border line before the age of two years. Type 3 (RDL) showed an explosively developing lymphocytosis. Passage of the border line occurred during the first year or, at the latest, during the second.

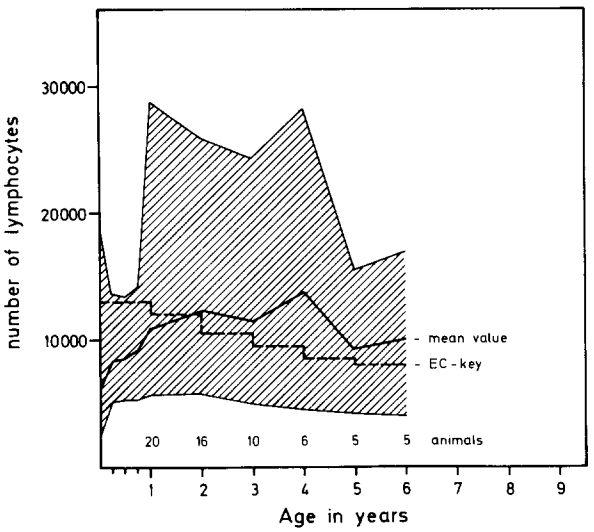

Fig. 3. Mean values and distribution of lymphocyte counts of calves fed with colostrum and milk from their leukotic dams (group 2)

Also, when the percentage of animals passing over the leukosis key border line was determined according to age, no significant difference was detected between groups 1 and 2 (Fig. 4).

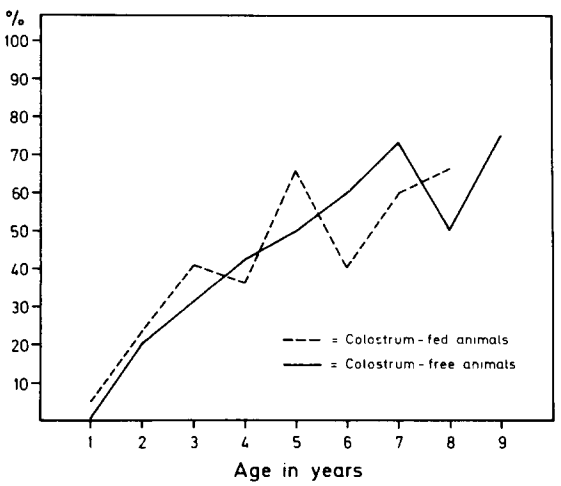

Fig. 4. Percentage of animals from leukotic dams with lymphoyte counts beyond the border-line of the EC-key

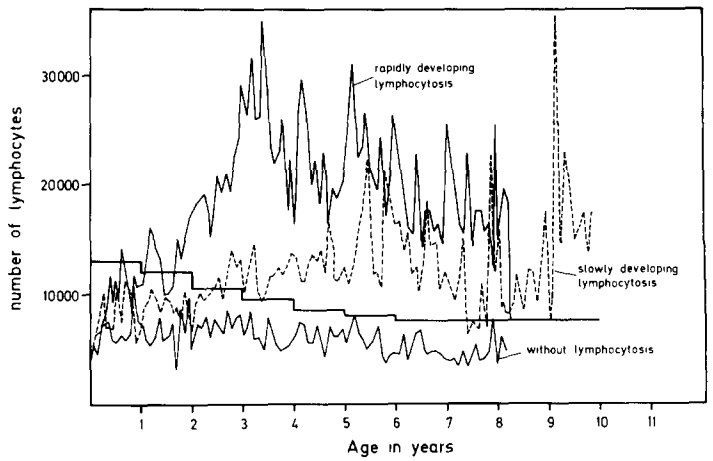

Fig. 5. Three different, yet distinct types of hematological behaviour of cattle derived from leukotic dams

The distribution of the animals (groups 1 and 2) according to this classification is summarized in Table 1. The RDL type (fed with colostrum and milk) was more frequent in group 2 than in group 1 (raised without colostrum and milk); but this difference, too, is not significant. When SDL and RDL types were compared, no differentiating quantitative effect of the factor "colostrum" was detected.

Table 1
Distribution of animals raised with or without colostrum, according to their type of lymphocytosis development

	without lymphocytosis	slowly developing lymphocytosis	rapidly developing lymphocytosis	sum
with colostrum and milk	4 (20%)	6 (30%)	10 (50%)	20
without colostrum	6 (33%)	7 (39%)	5 (28%)	18
sum	10	13	15	38

Finally, the mean values and the distribution of lymphocytes of animals belonging to the same type (Table 1), regardless of whether or not they had received colostrum and milk, were -for demonstration purposes- calculated and are summarized in Figures 6 - 8. It is obvious that the group of 10 animals without lymphocytosis resembles the group of calves born of nonleukemic dams (for comparison see Fig. 1). The group of animals with slowly developing lymphocytosis contains several that stayed for a long period in an equivocal stage. It is not until the fourth year that the average value crosses the border line (Fig. 7). The 15 animals representing the rapidly developing lymphocytosis type averaged very high counts already during the first months of life. After the second year no single value lies below the border line (Fig. 8).

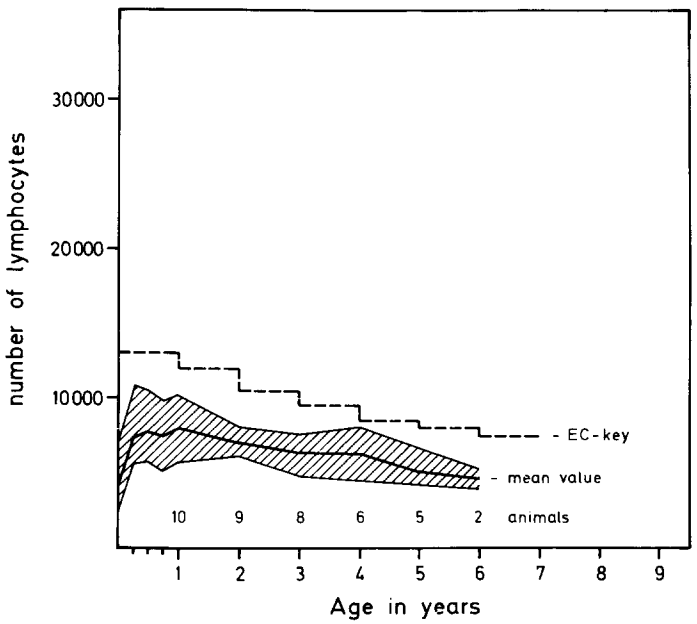

Fig. 6. Mean values and distribution of lymphocyte counts in animals without any lymphocytosis, derived from leukotic dams

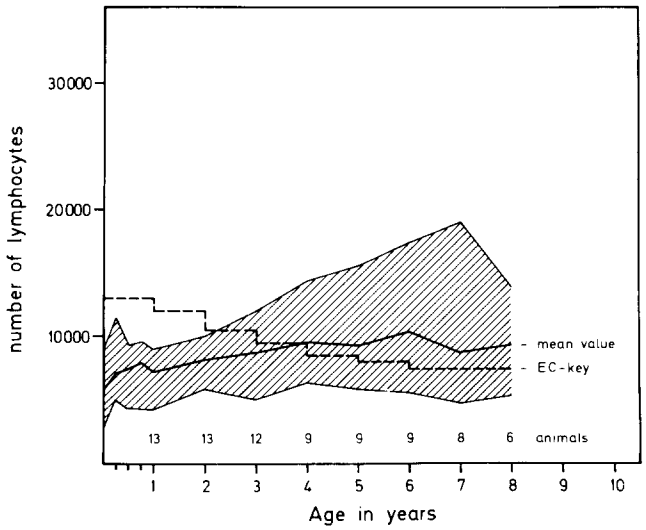

Fig. 7. Mean values and distribution of lymphocyte counts in calves with a slowly developing lymphocytosis

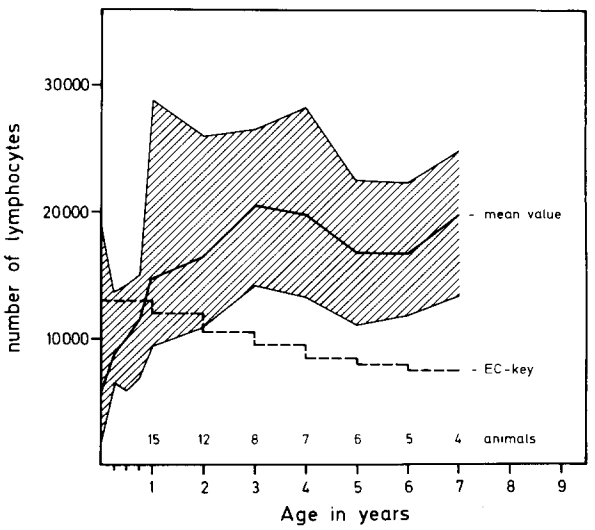

Fig. 8. Mean values and distribution of lymphocyte counts in animals with a rapidly developing lymphocytosis

Since from this data it could only be concluded that colostrum and milk do not seem to influence the development of

the lymphocytosis other factors such as genetic ones were taken into consideration, especially, because among the material presented there were a number of parent-offspring as well as brother-sister-relations. In one instance 4 pairs of animals were born of the same dams and in each pair both animals showed indeed the same type of lymphocytosis development, yet on the other hand there were another 6 pairs where the two animals of each pair differed from one another. The influence of the hematological status of the dam at the time of pregnancy or parturition was not given, as had been shown also earlier (Straub, 1969).

At present it must be concluded that neither environmental, nor simple genetic factors nor the feeding of colostrum and milk influences the development of the lymphocytosis. It is quite obvious that a number of animals developing leukemia or carrying the etiologic agent cannot be detected by means of hematological data. It is inevitable to conduct a large number of tests whereby the various serological methods are compared with the results obtained by determining the absolute number of lymphocytes, as has been done on a small scale (Frenzel, et al., 1975).

Other questions that need to be investigated in future laboratory work include, for example:

Do animals of the rapidly developing lymphocytosis type also produce and shed more virus than animals of the other types? Are there strains of bovine leukosis virus with different virulence? Are the productions of antibodies and their titer in any way related to the type of lymphocytosis or the development of the tumors?

References

1. Albrecht, A., Garcia de Lima, E., Geldermann, H., Mitscherlich, E., und Schmidt, Fr.-W., 1974: Untersuchungen über die Epidemiologie der enzootischen Rinderleukose und die Wirksamkeit des derzeitigen Leukosebekämpfungsverfahrens in Niedersachsen. Zbl. Vet. Med. B, 21, 520 - 539.

2. Frenzel, B., Mussgay, M., Schneider, L. G., and Straub, O. C., 1975: Immunofluorescence test for bovine leukosi associated complement-fixing antibodies.
Zbl. Vet. Med. B, 22, 519 - 523.

3. Lorenz, R. J. and Straub, O. C., 1976: Untersuchungen über die Gültigkeit des Leukoseschlüssels auch für andere Rassen als Schwarzbuntes Niederungsvieh.
Zbl. Vet. Med. B, 23, 1 - 26.

4. Straub, O. C., 1968: Zur Bedeutung der persistierenden Lymphozytose für Rückschlüsse auf die Ätiologie der Rinderleukose.
Zbl. Vet. Med. B, 15, 156 - 162.

5. Straub, O. C., 1969: Versuche über die vertikale Übertragung der Rinderleukose.
Dtsch. tierärztl. Wschr. 76, 365 - 368.

6. Straub, O. C. und Weinhold, E., 1971: Zur Frage der Übertragung boviner Leukose durch Kolostrum und Milch.
Dtsch. tierärztl. Wschr. 78, 441 - 444.