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Age Distribution of Naturally Occurring Acute Babesiosis in Cattle in Sweden

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Christensson, D. A. and M. A. Thorburn: Age distribution of naturally occurring acute babesiosis in cattle in Sweden. Acta vet. 1987, 28, 373-379. The age distribution of clinical cases of babesiosis reported by local veterinary practitioners was investigated in 1976 and 1981. The first study was based on material collected primarily for identifying the Babesia species, the second on computerized reports from a part of one county in Sweden.

The results were similar. Most diseased animals, 135/165 (82%) and 145/161 (90%) respectively, were more than 2.5 years old (cows), while 27/165 (16%) and 12/161 (8%) respectively, were 1-2.5 years old and only 3-4 (2-3%) animals were calves less than 1 year old. This age group, however, probably did not meet the same infection risk as did older animals. Among cows (>2.5 years old) there seemed to be no influence of age on the distribution of clinical babesiosis. Calculation based upon the entire animal population of the county investigated in 1981 revealed that clinical babesiosis was reported about 11 times more often among cows than among heifers and steers. The comparatively high resistance among 1-2.5 year-old cattle may be a function of an inverse age resistance, and/or may be influenced by vaccination against babesiosis on »high risk« farms in Sweden and a lower risk of infection on other farms such that animals tend to escape infection prior to adultness. Babesia organisms were found in 156 of 165 cases (95%) reported as clinical babesiosis.

Babesia divergens; clinical babesiosis; inverse age distribution.

Introduction

Field observations have indicated that »calves and heifers« usually are much more resistant to clinical babesiosis than are older animals (*Smith & Kilborne* 1893, *Riek* 1968). Also in Sweden clinical babesiosis seems to be more common and more severe in adult cattle than in younger animals. *Heijbel* (1928) observed that clinical babesiosis usually occurred in a mild form in Swedish calves. Even in 1-2-year-old animals the symptoms were less pronounced than in adult cows.

The aim of the studies presented here was to define the age distribution of reported clinical cases of bovine babesiosis in Sweden.

Materials and methods

Two studies were conducted. One was carried out in conjunction with a survey designed to define the bovine Babesia species occurring in Sweden. The other was based on clinical cases of babesiosis reported to the National Board of Agriculture (NBA).

Study A

In the first study 52 local veterinary practitioners were asked to draw heparinized blood samples from any cases of clinical babesiosis in cattle which they observed and to fill in a questionnaire on owner, address, age, and sex of animal. The study was under-

taken from the 1st of May 1976 to the end of April 1977.

The local veterinary practitioners represented all counties where Babesia was reported in NBA annual reports (1971-1975). They comprised, however, a non-random convenience sample, consisting primarily of colleagues willing to take part in an investigation. A total of 169 blood samples were obtained, which is 3.8% of all cases reported for babesiosis in the period. In 4 cases information about age was not given.

Thin films made from the blood samples were stained with acridin-orange (*Winter* 1967, *Trees* 1974) and Giemsa and scrutinized for the presence of Babesia.

The animals were grouped in the following age categories: animals younger than 1 year (<), animals 1-2.5 years old (1-2.5), animals more than 2.5 years old (>2.5). These age limits were used in order to be in closest possible accordance with the Official Statistics of Sweden, which groups the animals as »calves up to 1 year old«, »heifers and steers«, and »dairy cows« and »suckling cows« which here are calculated together as »cows« from the Yearbook of Agricultural Statistics (YAS) and Statistical Abstracts of Sweden (SAS). Thus, the age limit of 2.5 years (30 months) was close to the average age of the first calving, which is 29.7 months of age in dairy cows (*Hökås* 1981). The age group comprising animals of more than 2.5 years of age would presumably include only very few heifers.

Study B

The second study included cases of clinical babesiosis reported to the NBA from all local veterinary practitioners in the southern part of the county of Kalmar in 1981, where clinical babesiosis has the highest incidence (NBA annual reports 1971-81) and where vaccination is common (*Olsson* 1961). The reports of all animals examined in 1981 were computerized. Each record included data on farm identity, day of examination and disease diagnosed and in most cases animal identity.

Date of birth and identity of cattle owned by members of the Association for Swedish Livestock Breeding and Production (ASLBP) were kept in another computerized register. These registers were merged. Within the county 44.2% of the cattle population belonged to members of the ASLBP (*Hökås* pers.comm) and among this population 229 cases of reported clinical babesiosis were recorded. Of these the age was established in 161 (70%) cases. All but one were females.

In 1981, a total of 627 cases of clinical babesiosis were reported from the county of Kalmar (NBA, 1981). The period investigated was restricted to the 1st of June until the end of September 1981. Vaccination against babesiosis was finished on the last of May that year and cases wrongly recorded in the data base of NBA as clinical babesiosis instead of prophylactic treatment (vaccination) of babesiosis could then be excluded from the reports.

It was not possible to determine the age distribution of cows >2.5 years of age in the ASLBP register. However, the number of calvings per cow in the ASLBP register was known. Assuming that a dairy cow will deliver one calf per year it was possible to compare the age distribution of diseased cows (animals >2.5 years) with the distribution of number of calvings (age >2.5 years) of the total cow population of members of the ASLBP.

This distribution was calculated from the register of 1979-1980 of cows with 1-8 calvings.

In both studies the age of the animal is calculated from the day of disease diagnosis.

Results

The results are presented in Tables 1-4.

Table 1, which presents results from both studies, shows that 82%, and 90% respectively of cattle reported having clinical babesiosis were more than 2.5 years old, 16%, respective 8% were of the age category 1-2.5 years old and only 2% and 3% respectively were less than 1 year old.

Table 1. Age distribution of cattle with clinical babesiosis, reported by veterinary practitioners.

Age	Animals from Study A		Study B	
year(s)	n	%	n	%
<1	3	1.8	4	2.5
1-2.5	27	16.4	12	7.5
>2.5	135	81.8	145	90.0
Total	165	100	161	100

Study A: All counties where babesiosis previously is known to be present - 1986.

Study B: Southern areas of Kalmar county - 1981.

Table 2 lists the relative age distribution of the animals older than 2.5 years (cows) in the Kalmar study and the relative distribution of cows of the ASLBP cow population with 1-8 calvings. The relative distribution of diseased cows was comparable (non-significant X^2 goodness-of-fit, $p > 0.50$) with the observed relative age distribution of normal cows, expressed as number of calves per animal.

Table 2. Age distribution of adult cattle (>2.5 years) with clinical babesiosis (NBA annual report) of ASLBP members in the southern part of the county of Kalmar (Study B) and of the calculated number of cattle[1] of Swedish ASLBP members.

Age of the cattle	Distribution (%) of adult cattle: With clinical babesiosis	Totally of ASLBP
Years	n = 145	N = 410474
2.6- 3.5	32	33
3.6- 4.5	21	23
4.6- 5.5	21	16
5.6- 6.5	13	11
6.6- 7.5	6	7
7.6- 8.5	5	4
8.6- 9.5	1	2
9.6-10.5	1	2

[1]Extrapolated from data of cattle associated with the cow control in Sweden (Association for Swedish Livestock Breeding and Production), with reference to numbers of calvings.

Table 3 presents estimates of the age-specific annual incidence rates (1977) of clinical babesiosis in Swedish cattle using the total

Table 3. The distribution of age-specific rates of clinical cases of acute babesiosis in Sweden in 1976 calculated from the age distribution found in study A:

Age group year(s)[1]	Study A n	Calculated total	No. of animals[3]	Age-specific rates
<1	3	80	551366	.0001
1-2.5	27	725	581798	.0013
>2.5	135	3625	729450	.0050
Total	165	4430[2]	1 862614	.0024

[1]Corresponding groups by Official Statistics of Sweden are: <1 year; calves younger than 1 year of age. 1-2.5; heifers, bulls and steers 1 year of age and older. >2.5 years; dairy and suckle cows.

[2]Total number of cases of clinical babesiosis reported from NBA annual report 1976.

[3]From YAS 1977 for all of Sweden.

Table 5. The distribution of age-specific rates of clinical cases of acute babesiosis in ASLBP members in south Kalmar county 1981 calculated from the age distribution found in study B.

Age group year(s)	Study B n	Calculated total	No. of animals	Age-specific rate
<1	4	6	11775	.0005
1-2.5	12	17	12817	.0013
>2.5	145	206	14352	.0144
Total	161	229[1]	38944[2]	.0059

[1]Total number of cases of clinical babesiosis reported from members of ASLBP in the period investigated.

[2]Total number of animals of ASLBP members in investigated areas (**Hökås** pers.comm. 1981).

number of animals of different age groups in Sweden as given by SAS, as the population at risk. Since only slightly more than 85% of the Swedish cattle stock are located in those areas (YAS 1976-1981) where babesiosis is reported (*Wahlgren et al.* 1984) the age-specific rates in the population at risk are most likely somewhat higher than reported in Table 3.

Table 4 presents the estimated age-specific clinical babesiosis incidence rates of ASLBP members in the investigated area of study B. From these tables it appears that the percentage of clinical cases reported were 4-11 fold higher among cows than among heifers and steers.

Babesia organisms were found on 94.5% of the acridin-orange stained blood smears from cases reported as clinical babesiosis in study A. The only species identified was B.divergens. Findings distributed per age group was: calves <1 year 33.3%, 1-2.5 years 85.2% and cows >2.5 years 97.8%.

Six cases of verified babesiosis occurred from the 1st of November 1976 to the 15th of April 1977, which *was* winter time in Sweden when most animals *are* housed indoors. All animals were of the age group more than 2.5 years old and all were previously vaccinated against B.divergens before 2 years of age.

Discussion

The two surveys on age distribution of cattle reported to have had clinical babesiosis showed that clinical symptoms were most common among cows (>2.5 years of age). Clinical cases among heifers and steers were less common. Among calves up to 1 year of age clinical cases were rare (Table 1). The relative risk of contracting clinical babesiosis is 4 times higher for cows than for heifers and steers calculated for all of Sweden (Table 3) and about 11 times higher for cows in the southern part of Kalmar county (Table 4).

The accordance of the results of the separate studies, conducted at 5 years interval, from different sources, increases the reliability of the findings. They are also in good agreement with earlier observations made by local veterinary practitioners in Sweden (*Heijbel* 1928, NBA annual report 1975). A report from Scotland (*Adam & Blewett* 1978) also indicated a higher disease rate in adult animals. However, retrospective studies in the Republic of Ireland by *Gray et al.* (1983) and in Northern Ireland by *Taylor* (1983) found that 2-3 times as many heifers and bullocks than cows had been treated by the local veterinary practitioner or the farmer himself for clinical babesiosis (B.divergens). This is al-

most opposite to the situation found in Sweden. The difference in the age distribution of reported cases of clinical babesiosis of cattle in Ireland and Sweden may be explained by the fact that the incidence of reported clinical babesiosis in the studied area in Ireland was 30-40% (*Gray et al.* 1983) which is about 6 times higher than in the studied part of the county of Kalmar, 5.7% per year. The very high incidence in Ireland may reflect a high infection rate with possibly most animals becoming infected before they reach adulthood; a subsequent natural booster infection before loss of immunity would thus reduce the risk of a primary clinical infection among adult cattle. In Sweden, on the other hand, the low incidence (Tables 3 and 4) (*Wahlgren et al.* 1984) may create a higher risk for adults due to either a primary infection or an infection after lost immunity.

In Sweden vaccination against babesiosis is widely used (*Bodin & Hlidar* 1963, *Christensson* 1979). About 35% of calves born in 1979 in the county of Kalmar and about 18% of all calves in Sweden, were vaccinated, calculated from statistics on the calf population (YAS 1979) and on vaccine sold by the NVI. The vaccine is recommended for use on farms with a record of common occurrence of clinical babesiosis. The Swedish farmers vaccinating annually felt that the incidence of clinical babesiosis was markedly reduced among heifers and steers on pasture (*Bodin & Hlidar* 1963). This is supported by controlled observations made in Australia where just over 1% of vaccinated cattle were clinically affected during field attacks, but the incidence in controls was almost 18% (*Emmerson et al.* 1976).

The influence on age distribution of vaccination of up to 35% of heifers and steers before their first grazing period, perhaps the group at highest risk, is not evaluated in this study, but may also contribute to differences in the age distribution of reported clinical babesiosis in Sweden and in the Irish areas (*Gray et al.* 1983, *Taylor* 1983). This matter is the object of further studies.

Most cattle exhibited clinical babesiosis when grazing. More than 90% of the heifers and steers and about 90% of the cows will be on pasture from about mid May to the end of August, September (*Hökås* pers. comm) when the vector tick Ixodes ricinus has its active periods (*Nilsson* 1978). However, all pastures are not at equal risk for tick attack. The dairy cows are usually kept on cultivated land, i.e. aftermath, while heifers and steers more often are kept on less productive, bushy fields, presumably more preferred by ticks. This would cause a higher infection risk in the category of heifers and steers than among cows. This is, however, not reflected in the age-specific disease distributions. The younger calves are usually not exposed to the same risk, as they often are kept indoors or in paddocks until some 5-7 months of age. The proportion of calves on pasture is estimated to be 1/6-1/4 of the total population of calves (*Hökås* pers. comm). The only calves found with clinical babesiosis in these studies were older calves, 8-11 months of age.

Study B seems to be a reasonably representative sample from the cattle population at risk in all of the county of Kalmar as the estimated overall June to September 1981 incidence rate for clinical cases, 0.059, (Table 4) corresponds well with figures from the NBA annual reports for the county of Kalmar 1972-1976 which fluctuate between 0.06 and 0.08. By having restricted the investigation to members of organized production control (ASLBP) and excluded the first weeks on pasture, the incidence rates in study B may be somewhat underestimated.

The relative distribution of the diseased cattle more than 2.5 years old of the Kalmar stu-

dy is very close to the relative distribution of cows of the ASLBP register of all Sweden having had 1 to 8 calvings. This implies that cattle of more than 2.5 years of age were at equal risk irrespective of age and that a reverse age resistance does not occur among adult cows.

Study A may not form a representative sample of the Swedish cattle population. The intention of that study was to obtain blood samples from clinical cases of babesiosis from all areas where the disease is reported in Sweden. The age-distribution found in the study (Table 3), however, resembles that in study B, and therefore may possibly reflect the true age-specific rate distribution.

Babesia parasites were not found in 5.5% of cases in Study A clinically diagnosed and reported as babesiosis. This, however, had no major influence on the relative age distribution of heifers and steers and cows with reported clinical babesiosis.

Clinical babesiosis in winter time, when ticks are supposed to be inactive, has been reported previously in Sweden (*Christensson et al.* 1975). The 6 cases reported in study A were not further investigated but a »breakthrough« of chronic babesiosis may be a result of an occasional breakdown of the resistance of the animal caused by other diseases or treatments (*Blood & Henderson* 1960, *Mahoney* 1972, *Christensson et al.* 1975). An idea introduced by *Rosenberger* (1970) that tick survivors in the dried hay may transmit Babesia by an intraruminal bite has, however, never been further evaluated.

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Sammanfattning

Åldersfördelning av naturligt uppträdande akut babesios hos nötkreatur.

Åldersfördelningen bland nötkreatur rapporterade för babesios undersöktes 1976 och 1981. Vid första tillfället insamlades blodprov för undersökning av Babesia-art, vid andra tillfället användes datorbaserade rapportsammanställningar från södra Kalmar län. Resultaten var samstämmiga, 135/165 (82%) resp. 145/161 (90%) var djur (kor) äldre än 2,5 år och 27/165 (16%) resp. 12/161 (8%) var 1-2,5 år gamla och endast 3 resp. 4 djur (ca 2%) var kalvar under 1 års ålder. Kalvar löper troligen dock inte samma risk att bli infekterade som äldre djur, vilka oftare går på bete. Bland kor (>2,5 år) sågs inget samband mellan stigande ålder och antal rapporterade fall av babesios.

Omräknat på hela nötkreaturspopulationen ingående i nötkreaturskontrollen inom södra Kalmar län rapporterades babesios ca 11 gånger så ofta hos kor som hos ungdjur, 1-2,5 år gamla. Denna resistens hos djur 1-2,5 år kan förutom att vara ett utslag av omvänd åldersresistens även ha påverkats av att i Sverige vaccineras en stor del av kalvarna, ffa. på »högriskgårdar« innan de släpps på bete. Det är också möjligt att infektionsrisken på övriga gårdar är så låg att endast ett mindre antal djur hinner bli infekterade före vuxen ålder. Babesia-infekterade blodkroppar påvisades hos 156 (95%) av 165 undersökta fall rapporterade till Lantbruksstyrelsen som babesios.

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