Caprine arthritis encephalitis virus: prevalence and risk factors in Lebanon

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Summary

An epidemiological survey, accompanied by a serological analysis, was conducted on samples taken from Lebanese goat herds in order to determine the prevalence of infection with the caprine arthritis encephalitis virus (CAEV) in Lebanon. The results of the survey provided information on various livestock production, animal health and herd management factors.

Serum samples from 952 goats, including the local breeds (Baladi and Damascene) and imported breeds (Alpine and Saneen), were taken from 60 farms distributed throughout Lebanon and tested for the presence of anti-CAEV antibodies. The data obtained were analysed using a statistical model to assess CAEV infection risk factors in Lebanon.

In total, 125 samples proved to be positive, representing a prevalence in selected individuals of 13.13% and in selected herds of 51.67%.

The Bekaa region had the highest number of herds with seropositive goats (90% of herds); the level was lower in Mount Lebanon, the

North and the South (54%, 34% and 33%, respectively). The prevalence in relation to the livestock production system was 70% in herds in intensive systems, 54% in semi-intensive systems and 45% in extensive systems. The indigenous breeds were more resistant and tolerant of CAEV than the imported breeds.

This study confirms the presence of CAEV in Lebanese goat herds and identifies the different livestock production practices likely to favour the rapid spread of the virus.

Keywords

Caprine arthritis encephalitis virus – Goat – Lebanon – Livestock production practices – Serological survey

Introduction

The Lebanese goat production sector is relatively well developed, but productivity is low. There are some 495,000 goats, but, on average, they produce no more than 100 litres of milk per head per year (1). Productivity could be improved by better feed management, animal disease prevention and the strengthening of Veterinary Services (2). Inefficient herd management, inadequate training of farmers and lack of controls on animal movements between herds are the main obstacles to the development of the goat breeding sector. All these factors result in serious bacterial and viral infections that cause heavy economic losses in terms of goat meat and milk production; they also pose a risk to the health of farmers and consumers of goat products (2).

Caprine arthritis encephalitis (CAE) and maedi-visna (MV) are two viral diseases caused by a persistent small ruminant lentivirus. Recent studies have shown that the CAE virus (CAEV) can be a major cause of reduced goat milk production, so its control as part of herd health programmes is warranted (3). Similarly, an Australian study on Saanen goats highlighted the negative impact of the presence of anti-CAEV antibodies on various production factors, even in the absence of clear clinical signs (4). In multiparous goats, a reduction of almost

20% in both milk production and the lactation period was observed in seropositive females in comparison with seronegative females. In addition, a significant correlation was found between the presence of antibodies on the one hand, and an increase in fertility problems, a drop in birth weights, a decrease in kid growth rates and a higher incidence of concurrent infections, on the other (5).

CAE has been described on all continents and in many countries. The highest prevalence (greater than 65%) has been reported in countries where goat farming is intensive, such as Canada, France, Norway, Switzerland and the United States. In goat-importing countries, such as Kenya, Mexico, New Zealand and Peru, the prevalence is often below 10% (6, 7, 8).

In the Middle East, CAEV has been detected in Saudi Arabia, Syria, Jordan and Turkey, with prevalences of between 0.8% and 12.5% (6, 9, 10, 11). According to the World Organisation for Animal Health (OIE), Qatar reported the presence of CAEV in 2007, Israel reported it between 2007 and 2012, and Cyprus has been reporting it since 2006.

In Lebanon, few accurate studies exist to assess the real impact of the disease on goat production. Nevertheless, given its slow and progressive development and the diversity of clinical signs, there is no question that CAE is the cause of considerable direct and indirect loses in the goat production sector. Many farms are still facing serious clinical problems (goats with joint and teat conditions) that severely undermine their productivity and profitability.

The purpose of this study is to confirm the presence of CAEV in the Lebanese goat population and to determine its prevalence, as well as to clarify which of the various goat farming practices could have an influence on the spread of this virus in Lebanese goat herds.

Materials and methods

A multidimensional study was carried out in the form of two major experiments between September 2011 and March 2013. Experiment 1 was cross-sectional, covering the entire country in order to detect

CAEV and determine its prevalence in Lebanese herds. Experiment 2 was vertical, focusing on specific farms in order to determine if there was a correlation between the occurrence of CAEV and certain body parameters measured during the study. The geographic distribution of the herds that were analysed and measured is shown in Figure 1.

Sampling

In total, 952 goats distributed over 60 farms – around 20 goats per farm – were randomly selected (representing more than one-tenth of the herd in the majority of cases). To avoid introducing an age bias between herds, only adult goats over one year old were selected for sampling and, on farms with fewer than 20 goats, blood samples were taken from all goats over one year old. The sampling of 20 goats in herds of between 50 and 200 goats allowed at least one infected animal to be detected, for minimum prevalence of 10% to 13%, with a probability of 95%. These calculations were made using Episcope software version 2.0 (12). The herds were divided into three categories: small (fewer than 50 goats), medium (50–100 goats) and large (more than 100 goats).

The herds were chosen at random throughout Lebanon: North (20 farms), Mount Lebanon (24 farms), Bekaa (10 farms) and South (6 farms).

A questionnaire was completed by livestock producers in order to collect information on the herd size, production system, breed and other health and herd management parameters.

In parallel, blood samples for serological analysis were taken from the jugular vein under aseptic conditions; the animals were restrained to ensure that they remained in an upright position.

Serological analysis

The sera collected were analysed to assess their content of anti-CAEV antibodies using the CHEKIT* CAEV/MVV antibody test kit, FLI-B 424, version 06-40799-02 (IDEXX Laboratories Switzerland AG).

The test microplates were sensitised alternately with a control antigen (–Ag) and an inactivated viral antigen (+Ag). The coloration obtained (by reading the optical density at 450 nm) was directly proportional to the quantity of anti-CAEV antibody in the tested sample.

When interpreting the results, a herd was considered to be infected by CAEV when at least one goat belonging to the herd gave a positive test result.

Statistical analysis

A distinction needs to be made between the apparent prevalence (AP), namely that obtained by a diagnostic test, and the real prevalence, which corresponds to the real value of the infection in the population and is related to the sensitivity and specificity of the test used (13).

In the interests of clarity, it is the AP that is given in all the following tables because the characteristics of the serological test (specificity and sensitivity) are not always precisely known.

The data collected using questionnaires was processed using SigmaSTAT software version 2.0. A threshold of statistical significance (p) of 0.05 was selected.

Carpal/metacarpal ratio

For Experiment 2, which was conducted to determine the relationship between certain body measurements and the occurrence of CAEV, 72 adult goats on 14 traditional farms in the Jbeil region were selected for measurement. The main measurements taken were the circumference (in centimetres) of the carpal and metacarpal bones of the selected goats. The CAEV infection status of the goats was also determined.

Results

Caprine arthritis encephalitis virus infection in Lebanon

The results of the anti-CAEV antibody detection tests (Table I) showed that 125 of the 952 goats tested had anti-CAEV antibodies, representing an individual prevalence of 13.13%.

The goats that tested positive were from 31 of the 60 herds sampled in the study. The infection rate at herd level was therefore 51.67%.

Variations in the level of infection by the caprine arthritis encephalitis virus according to region in Lebanon

According to the results in Table II, CAEV infection of Lebanese herds varied substantially between the different geographic regions, with the maximum recorded in Bekaa, where 90% of the herds analysed were infected, and the minimum in South Lebanon (33% of herds infected).

Variations in the level of infection by the caprine arthritis encephalitis virus according to farming practice

As Table III shows, the following four livestock production factors showed a significant statistical relationship ($p < 0.05$) with CAEV infection:
– livestock production system
– transhumance
– breed
– presence of sheep.

Conversely, the herd size had no effect on the occurrence of the disease.

Herds under an intensive production system had the highest infection rate (70% positive results), while the infection rate was 54% in extensive systems and 45% in semi-extensive systems. Where there were foreign breeds, the CAEV infection rate was also found to be very high (up to 75%).

Non-transhumant herds had higher infection rates (65%). The presence of sheep in goat herds also appears to be a factor that favours infection, because 68% of goat herds also containing sheep were infected by CAEV.

Variations in the level of infection by the caprine arthritis encephalitis virus according to body parameters

Body measurements were taken from the goats in the area around the knee that is related to the occurrence of the disease (carpal and metacarpal bones). The results of these measurements are given in Figure 2.

No significant difference was reported concerning the best known clinical sign, namely arthritis or 'big knee'. The average circumference of the largest carpal bone (knee) was 13.4 cm in groups of seropositive goats and 13.3 cm in groups of seronegative goats. The smallest metacarpal (lower knee joint) measured 8.5 cm in seropositive goats and 9 cm in seronegative goats.

Discussion

The lack of published studies on the CAEV situation in Lebanon makes the present study one of only a few devoted to the epidemiology of CAEV infection in goats in different livestock production contexts in Lebanon.

This study finds a higher herd prevalence (51.67% of herds infected) than that reported by other authors in Jordan (23.2%) (6), central Mexico (28.6%) (2), Turkey (1.9%), southern Mexico (3.6%) and the United Kingdom (10.3%) (11, 14, 15). The high levels found in Lebanon are probably due to unregulated trade in animals among herds. However, they are lower than the levels reported in Australia (82%) and the United States (73%) (16, 17).

The individual prevalence (13.13%) is virtually the same as the rates in Jordan (12.2%) (5) and Syria (12.1%) (10), but lower than the rates in Switzerland (42%) and the United States (31%) (17, 18, 19).

However, it is higher than the rate reported in Saudi Arabia (1.9%) (9).

The results show significant variations between the four Lebanese regions covered by the study, with the Bekaa plain, where 90% of herds are considered to be infected, the worst affected. The results for Bekaa, the highest compared with the national average, may be explained partly by the modest scale of sampling, which does not necessarily reflect the true situation, and partly by the fact that a large area of the Bekaa plain is exposed to the border, which facilitates unregulated trade in animals. This trade is considered to be one of the main causes of horizontal transmission of this type of virus (20).

As for the correlation between livestock production factors and CAEV infection, some authors (21) believe that the herd size has no impact on the serological prevalence of CAEV, while others see this as one of the most important factors influencing the prevalence of CAEV (19, 20). A statistical analysis of the results in Lebanon shows that the herd size has no significant impact ($p = 0.966$) on the serological prevalence of CAEV. This finding is similar to that reported in Canada, but conflicts with that reported in Jordan (6).

As most of the goats infected with CAEV are asymptomatic carriers (14, 18, 21) and hygiene is one of the most important transmission factors, it is reasonable to assume that the other livestock production factors studied (production system, transhumance, breed and presence of sheep) influence the rate of CAEV infection (14, 18, 21).

With regard to production systems, 70% of herds under an intensive system were found to be infected with CAEV. This corresponds with the bibliographic data (22), as under the intensive system animals can be imported, those kidding are often grouped together and the colostrum is often mixed with the milk – all of which substantially increase the risk of contamination.

Similarly, the goat breed seems to play a role in the distribution of CAEV infection in Lebanon because in farms where several breeds were present (Baladi, Shami and Saanen and/or Alpine), 75% of herds

proved to be infected ($p < 0.05$). Conversely, infection rates in herds of local breeds were lower (35%). This could be due to the fact that indigenous breeds are more resistant and tolerant than other breeds to CAEV infection (23).

These results are open to two interpretations:

– CAEV was introduced into the different farms when importing foreign breeds of goat (the rate of CAEV infection being much higher in countries that use intensive production systems) (24)

– there are local strains of CAEV or MV virus of sheep.

The latter hypothesis looks the more likely in the light of the results obtained in farms that keep both goats and sheep, where infection rates are higher. These results are consistent with other studies, which reported a higher rate of infection in goats that were in contact with sheep carrying the MV virus (20, 24).

Although arthritis or swelling of the knee ('big knee') are the best known clinical signs, the body measurements carried out revealed no significant difference between the knee size of seropositive and seronegative goats. These results corroborate the field data, as clinical signs of the disease were generally not observed during the survey and livestock producers reported them only seldomly, if at all. Despite the high level of seropositive results, in Lebanon it is difficult to find clinical manifestations proving CAEV infection. This finding is consistent with the descriptions of viral CAE as a disease characterised by a high herd prevalence of subclinical infections (25).

This is probably linked to farming conditions that are unconducive to clinical expression of the disease, which depends on certain animal husbandry parameters. Animals farmed under conditions that are hard on the joints are particularly exposed to arthritis and animals subject to poor milking conditions often suffer from chronic mastitis.

Conclusion

This study provides a general overview of viral CAE affecting goats in Lebanon. This disease poses serious animal health problems that constrain production, despite the absence of apparent clinical signs.

The study identifies a very high rate of CAEV infection at herd level compared with individual serological prevalence. This substantial difference, which is not found in neighbouring countries (Jordan, Turkey) shows, first, that uncontrolled animal trade between herds (imports and domestic trade) is probably one of the main factors causing the excessive infection rate of Lebanese herds and, second, that the indigenous breed (Baladi) is comparatively more resistant than other breeds.

To put things in perspective, it should be noted that the results of screening over a given period are only indicative. To understand the development of this disease over time, it is vital to repeat the diagnosis at regular intervals in order to prevent the severe socio-economic problems caused by CAE in the goat farming sector and to curb its impact on public health.

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Table I

Prevalence of viral caprine arthritis encephalitis in Lebanon

	Total	Positive results from serological screening
No. of animals tested	952	125
Individual prevalence		13.13%
No. of herds tested	60	31
Herd prevalence		51.66%

Table II

Herd prevalence of infection by the caprine arthritis encephalitis virus in the four regions of Lebanon

Region	No. of herds tested	No. of herds infected	Prevalence
North	20	7	35%
Mount Lebanon	24	13	54.16%
Bekaa	10	9	90%
South	6	2	33.33%

Table III

Influence of production system factors on infection by the caprine arthritis encephalitis virus

Factors	Category	Number	Serological results from the CAEV detection test		*p*
			Positive (%)	Negative (%)	
Herd size	Small	20	12 (60)	8 (40)	0.966
	Medium	21	10 (47.61)	11 (52.38)	
	Large	19	8 (42.1)	11 (57.89)	
Livestock production system	Intensive	10	7 (70)	3 (30)	0.002
	Extensive	28	15 (53.57)	13 (46.42)	
	Semi-extensive	22	10 (45.45)	12 (54.54)	
Transhumance	Yes	20	4 (20)	16 (80)	0.001
	No	40	26 (65)	14 (35)	
Breed	B	17	6 (35.29)	11 (64.7)	0.001
	D	9	3 (33.33)	6 (66.66)	
	F	6	4 (66.66)	2 (33.33)	
	B+D	14	9 (64.28)	5 (35.71)	
	B+D+F	14	10 (71.4)	4 (28.6)	
Presence of sheep	Yes	28	19 (67.85)	9 (32.14)	0.001
	No	32	14 (43.75)	18 (56.25)	

B: Baladi

D: Damascene

F: foreign breeds

CAEV: caprine arthritis encephalitis virus

Fig. 1

Survey on caprine arthritis encephalitis in Lebanon: geographic distribution of goat herds tested nationwide
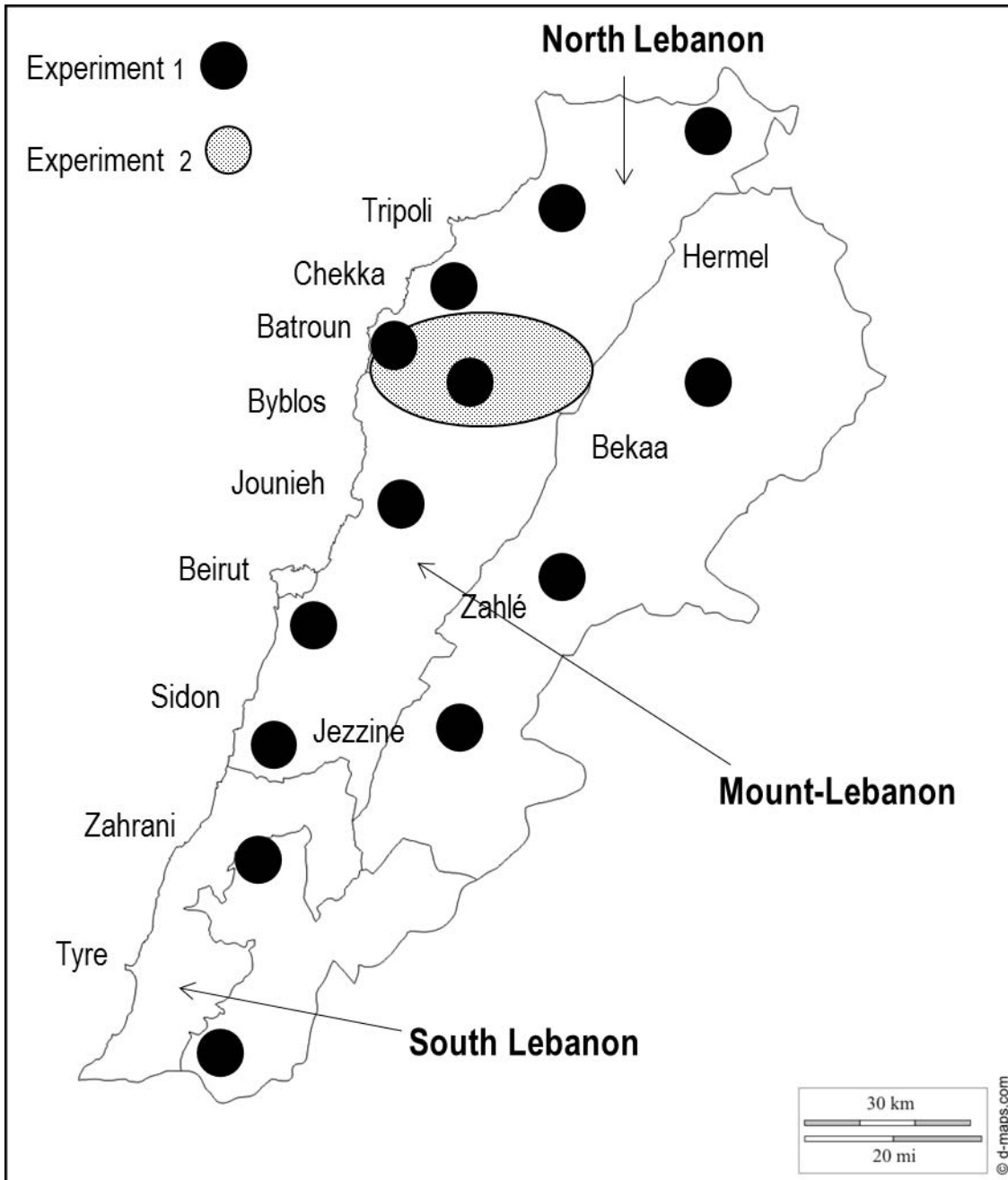
Fig. 2

Body measurements (centimetres) and standard deviation bars indicating swelling of the knees in goats that returned positive and negative results for the caprine arthritis encephalitis virus detection test