

Mating and Spread of Caprine Arthritis Encephalitis (CAE)

Dr Sandra Baxendell

Accreditation schemes in Australia and the United Kingdom do not allow for the entry of non-accredited goats unless they are first quarantined (generally for 6 months) and then tested negative. Untested or positive does coming onto a CAE accredited herd for a quick mating by an accredited buck is not allowed. According to the Australian Animal Health Committee's Sub-Committee on Animal Health Laboratories Standards' CAE protocol states there is ".....lateral transmission to animals (of any age) if close contact does occur. This is considered to require intimate contact of mucosal surfaces with milk, vaginal, preputial, anal, nasal, conjunctival or oral discharges from an infected goat."ⁱ Mating certainly can be classified as "intimate contact".

Also there is the danger of fomites (e.g. goat body fluids on owner's clothing or shoes) coming with the doe and its owner. Fomites can spread CAE between herds.ⁱⁱ

CAE Free Buck Over Positive Does

CAE positive does are infected for life and contain the CAE virus in their white blood cells and macrophages, hence potentially all their tissues which contain these cells. The genital tracts of ewes with lentivirus have been shown to contain large numbers of virus.^{iiiiv}

Vaginal secretions have large numbers of white blood cells that are potentially infected with CAE. The oestrus cycle and hormones affect the number of white blood cells in vaginal mucus in both animals^v and even people^{vi} and this has been known since 1929^{vii}. The vagina of animals is "self-cleaning" and protected from bacteria by a combination of mucus and white blood cells.^{viii} The number of white blood cells increases in times of greatest need i.e. when mating is likely. A South African study graphed all the cell types including the white blood cells, which dramatically increased from a couple of days before oestrus and were still high until day 12 after oestrus.^{ix} After oestrus, these white blood cells are replaced mainly by shed cells from the vaginal lining. White blood cells are relatively few in mucus of pregnant animals. ^x Before the widespread use of ultrasound machines to visualize the ovaries, vaginal smears were used to identify animals in oestrus.

"CAEV-infected cells have been demonstrated in the oestrus mucus of does".^{xi} The model for the entry of CAE virus via oestrus mucus is the same as the model for the detection of pheromones (chemical signals) by the buck from the does on heat. Vaginal secretions and urine are known to contain pheromones to which the buck responds. His response includes "flehmen, a conspicuous posture characterized by eversion of the upper lip with the head held high. This response is designed to help the transfer of these chemicals to the vomeronasal organ."^{xii} The vomeronasal organ is a tubular organ connected via the nasopalatine duct to the mouth and nasal cavity.^{xiii} It is very well developed in ruminants and lies at the base of each nasal cavity stretching along the sides of the septum. Of particular interest is the connection at the other end directly to the brain. While this organ's role is to smell it also is capable of producing secretions.^{xiv}

Interestingly it is not just males that display flehmen, with females also displaying this behaviour and preferring to sniff the urine of females that are breeding or post parturition.^{xv} This may therefore account for some of the transfer of infection between adult does.

A very experienced breeder of goats in Western Australia, who worked closely with CAE researchers Dr Ellis and Dr Robinson, reported her view that “CAE negative bucks used over CAE positive does are highly likely to become positive themselves. It would seem that the bucks pick up the doe's body fluids during mating or from licking the mucous from her rear end.”^{xvi}

One of the issues with serological testing is that there are few adult males in most goat herds. One study in the USA in 1981 found that 73% of 324 goats from 19 herds were positive for CAE. This included 100% of the 14 bucks tested.^{xvii} A survey of goat herds in New South Wales in Australia found a higher percentage of reactors amongst males (36.1%) as compared to females (27.9%).^{xviii} Similarly in Brazil, bucks had a higher serological positive rate of 28.3% compared to does with only 5.9% serologically positive rate.^{xix} Recent research in Poland found a high correlation between males testing positive for CAE and the incidence in females in the herd.^{xx}

Another issue is that often the laboratory is not informed of the sex of the animals sampled as the identities of the blood samples are held by the private veterinarian. Collating for any sex predilection is therefore not possible by laboratories or researchers. Most of the reports in the scientific literature about incidence of CAE in countries do not report on the sex of the goats sampled.^{xxi xxii xxiii xxiv xxv xxvi}

Positive Bucks over Negative Does

It is shown by many researchers that the semen of bucks can contain the CAE virus^{xxvii xxviii xxix xxx xxxii}, although few studies have been done re transmission of CAE virus via naturally infected semen. Research has shown that the CAE virus can grow in the epididymis and be shed into the duct and hence into semen.^{xxxiii} One study in sheep looked at whether rams that were serologically positive for the Small Ruminant Lentivirus could transfer the disease to their lambs conceived by AI and found no such cases in the small number (19 ewes) studied.^{xxxiv} A research trial was done with 4 groups: controls, naturally infected bucks, and 2 groups infected artificially with 2 different strains of CAE. Each group has their semen & blood tested every month. The naturally infected group was positive on blood & semen tests each month. The artificially infected groups became positive after 3 months & 7 months for the 2 different strains. Controls remained negative. At the end of 10 months the bucks were post-mortemed and their reproductive tracks examined. Two of the artificially infected bucks had small lesions. While testing semen is not as practical as blood samples, it is suggestive that on post-mortem, seminal vesicles, ampulla and bulbourethral glands all tested positive to CAE antigens. All the seminal fluids (except the control groups) were positive for CAE by PCR tests.^{xxxv}

Unfortunately there have been a lot of cases where developing countries have imported better dairy genetics but buying goats from non-accredited CAE free herds and then finding out they had introduced CAE into their country. One such case was Kenya and this was written up as a case study.^{xxxvi} The Kenyan government imported 30 Nubian does, 4 Nubian bucks and 2 Toggenburg bucks from the USA and kept them in closed herds, except that the bucks were used over native does for a 6 week mating period in 1979 and 1980 and sometimes penned with native bucks. In 1980, nine of the imported Nubian does showed signs of arthritis and for 3 of the 9 were emaciated as well. In 1981, all the goats were blood tested and it was found that 80% of the imported goats and their progeny were positive for CAE. The Kenyan government then quarantined and destroyed all the goats on the farms with the imported goats. By this stage 50% of the imported goats were showing clinical signs of CAE. Kenyan authorities then blood tested all native does and bucks that had been in contact with

the imported bucks as well as native goats that had had no contact. Of the 555 goats that had had contact, there were only two positives. Also one native weaner male penned with the imported bucks for 5 months was found to be positive and was destroyed. They concluded that “under the conditions found in Kenya, horizontal transmission from bucks to does during the breeding seems to be inefficient or non-existent. Furthermore transmission via sperm to offspring did not apparently occur.”

Another outcome, besides all the imported goats being destroyed, was the reputation of USA goat breeders was jeopardized and this case study was used by US veterinary experts to put pressure on the US dairy goat community to clean up CAE.^{xxxvii} However progress in CAE eradication in the USA has been slow.

This case study is interesting but no guarantee that positive bucks cannot pass on CAE especially as native does were only tested once. One authority stated that “slightly higher seroconversion rates have been recorded in does hand-mated to infected bucks”.^{xxxviii} The reviewer then went on to suggest that small herds that do not keep a buck should consider artificial insemination rather than risk mating with an untested buck.^{xxxix} Another researcher also consider venereal transmission as a mechanism for the introduction of CAE into a herd and recommended using artificial insemination with washed extended semen as “preferred over natural matings”.^{xl}

Research in Brazil looked at high and low amounts of CAE virus added to semen that was then used to artificially inseminate (AI) 20 does (half in each group). Another 10 does were in the control group got semen with no added virus. Within 60 days, all inseminated does became positive on blood test, while the 10 control does remained negative for the next 12 months.^{xli} So if considering to use AI, you should ensure that the buck who is used as the semen donor, is tested negative for CAE on several occasions or better still come from a CAE negative or accredited herd. Other research has shown that it is possible with some slight adjustments to use seminal fluid to test for the presence of CAE antibodies, meaning that bucks in AI centres can easily be tested for CAE at regular intervals.^{xlii} However this research needs to be balanced against the findings from the Netherlands that the shedding of CAE in semen is intermittent. This research in rams and bucks showed that the presence of the Small Ruminant Lentivirus (ie CAE) is only intermittently found in their semen. They concluded "that a single PCR-negative semen sample cannot be used as a diagnostic tool to predict that subsequent ejaculates will be SRLV-free".^{xliii}

A recent review of artificial breeding techniques and CAE found that spread by Embryo Transfer was unlikely if the outer layer of the embryo was left intact and the embryo was washed 10 times.^{xliv} Another researcher found that while CAE virus was found in the first 3 washing fluids of embryos made with infected semen, no virus was isolated after subsequent washings.^{xlv} However they could not guarantee that Artificial Insemination (AI) did not spread CAE and were concerned that the risk of spread by AI could actually be higher due to the lack of protective cervical and vagina mucous secretions. They recommended that semen only come from bucks kept in free herds and regularly tested negative for CAE.^{xlvi}

A normal buck's behaviours during the breeding season including spraying, flehmen, sniffing, and mounting can contribute to lateral spread to does or other bucks. Also some bucks practice sodomy if kept in a male group, which increases the likelihood of lateral transfer to other bucks.^{xlviixlviii}

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