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An Epidemiologic Assessment of Bovine Viral Diarrhea Virus Infection in Alpacas

Due to the fact that Bovine Viral Diarrhea Virus (BVDV) continues to be a concern for alpaca owners, the Alpaca Research Foundation (ARF) awarded grant funding to two Iowa State University investigators so they could pass along critical findings about this virus in alpacas.

Dr. Julie Ann Jarvinen

Dr. En-Min (Eric) Shou and Dr. Julie Ann Jarvinen recently finished their study "An Epidemiologic Assessment of Bovine Viral Diarrhea Virus Infection in U.S. Alpacas." The major goal of this study was to test the blood of 200 randomly-selected U.S. alpaca herds for virus-neutralizing antibodies against two types of BVDV in order to determine how commonly and frequently alpacas are infected with the virus. They also wanted to see if there is a relationship between potential risk factors such as exposure to cattle or participation in shows and the presence of antibodies. Only alpacas older than six months were tested.

Dr. Jarvinen explained more about the study and the virus itself:

What exactly is BVDV?

BVDV is the abbreviation for bovine viral diarrhea virus. As the name of this virus implies, cattle are most commonly infected with BVDV, and the infection can cause diarrhea. In reality, however, this name is rather simplistic because BVDV can infect other animals, and diarrhea is only one of many possible consequences of infection.

How do cattle obtain the virus?

Calves can become persistently infected (PI) when BVDV crosses the placenta of an infected dam at a critical time in gestation before the fetal immune system has developed. The PI calf does not recognize BVDV as an invading organism in need of elimination, allowing the virus to infect the calf for the rest of its life. Because PI calves shed large quantities of BVDV, they are considered the primary source of infection for other cattle.

Explain the difference between a PI and BVDV-infected cow.

A persistently-infected cow and a BVDV-infected cow are the same in that both are infected with BVDV. However, they differ considerably in how long the virus can survive and multiply in the animal, and that is determined by the animal's immune system. The immune system must recognize the virus as "foreign" in order to destroy it. If BVDV infects a bovine with a competent immune system, the virus is recognized as a foreign substance, and the immune system eliminates it from the body in a matter of days or weeks. If BVDV infects a pregnant cow, the virus can cross the placenta and infect the fetus. If infection occurs

The Alpaca Research Foundation (ARF), in conjunction with Morris Animal Foundation (MAF) and other groups in the llama and alpaca communities, provides funding grants to veterinarians and scientists engaged in research that has the potential to improve the health and well-being of our animals. *Alpacas Magazine* is pleased to bring you another in a series of interviews with the researchers carrying on this important work.

at a critical time in gestation before the fetal immune system has developed, the fetus will essentially consider the virus as a normal body component rather than something foreign that shouldn't be there. In this case, even after the calf is born, its immune system won't recognize BVDV as foreign. As a result, the virus continues to survive and multiply in the animal for as long as it lives, i.e. the animal is "persistently infected" with BVDV.

How exactly do alpacas contract the disease?

Alpacas are presumably infected with BVDV the same way that cattle are infected: by direct contact with the virus present in virtually all bodily secretions and some cells of an infected animal. We know that PI animals are the most important source of infection for cattle because they continue to shed large quantities of BVDV in their urine, feces, nasal secretions, saliva, etc., for as long as they live. For alpacas, "spit" is probably an additional source of infectious virus. Animals that come in contact with these virus-laden substances when they are relatively fresh can easily become infected by ingesting or inhaling the virus. Animals that have a transient BVDV infection can also be a source of infection because they shed BVDV in their bodily secretions and excretions. However, they are far less significant than PI animals in the spread of infection because they shed low amounts of virus for a short period of time. An infected female alpaca can also transmit the virus to her fetus as described for cattle.

How does it affect alpacas?

As with cattle, the effects of BVDV infection in alpacas are quite variable and can mimic many other conditions. Unless laboratory testing is done, the infection could be easily misdiagnosed. The respiratory, digestive, and reproductive systems are most commonly affected, but in some cases, the signs are rather vague and include a poor appetite and lethargy, or there may be no obvious signs of infection. Infection of alpacas with BVDV during

pregnancy can result in early pregnancy loss, abortion, stillbirth, premature birth, or the birth of PI crias. Low birth weights and a hairy fleece have been described for crias that were infected in utero. Crias that are persistently infected might appear to be normal, but more often the PI alpaca has chronic health problems such as recurring diarrhea, pneumonia, nasal and ocular discharges, and poor weight gain.

Are there any recognizable signs of the virus in alpacas?

The signs of BVDV infection seen in alpacas are basically similar to those occurring in cattle. Although some of the signs noted in alpacas might suggest BVDV as a possible cause, the signs alone aren't sufficient for an unequivocal diagnosis. Laboratory tests to detect BVDV in the blood or tissues are necessary to definitively diagnose BVDV infection.

When was BVDV first recognized in the alpaca community?

BVDV first caught the Alpaca Research Foundation's attention in late 2004 to early 2005. *[See the article "BVD Virus: A Newly-Recognized, Serious Health Problem," by Nancy Carr, M.D. and Susy Carman, DVM, PhD in the Summer 2005 issue of* Alpacas Magazine. *– Ed.]*

How did you conduct your research?

We compiled a list by state of every alpaca breeder we could identify from various sources, randomly selected 10% of the breeders in each state from this list, and sent them a letter requesting their participation in the study. The owners who agreed to participate were asked to send two sets of blood samples to us from the same alpacas obtained at least one month apart. They also filled out a questionnaire to accompany each set of blood samples that provided information on herd composition, management practices, biosecurity, occurrences of disease in the herd, participation in shows, etc. The blood samples were tested for antibodies against BVDV Types 1 and 2 in the virus neutralization assay. The results of the antibody assay were then statistically analyzed to determine if the presence of antibodies correlated with any of the potential risk factors from the questionnaires.

What were your findings?

We received useable blood samples from 191 alpacas from 39 herds in 20 states. Three herds had at least one positive alpaca which translates into a national herd prevalence of 7.7%. Of the 191 alpacas tested, eight (4.2%) had antibody titers >4. We tested most of the same alpacas again at least one month later to determine the incidence (number of new cases) of BVDV infection. None of the individuals or herds that were initially negative for antibodies against BVDV was seropositive at the second sampling, suggesting no transmission of BVDV infection occurred during the time interval between samples.

Did you find a relationship between potential risk factors and the presence of antibodies?

We did not identify any associations between the presence of antibodies and potential risk factors for exposure to BVDV most likely because the low level of participation in the study didn't provide the statistical power needed to detect such associations. We needed to have at least 100 herds participate in the study in order to have a large enough sample size to detect significant risk factors, but only 39 farms provided the first set of samples and only 27 of these followed through with a second set of samples.

Were the findings different than you imagined?

Not as far as prevalence rates are concerned. The 4.4% prevalence rate of BVDV in individual alpacas that we found in this study is similar to prevalence rates previously reported in South America and Great Britain where prevalence based on antibody titers ranged from 6.6 to 11.5% in individual alpacas and 2.1 to 14% in llamas. Two previous antibody surveys in the U.S. reported prevalence rates of 0.9 to 13% for individual llamas and alpacas. However, none of these other studies evaluated the prevalence of BVDV at the herd level and none looked at the incidence of infection.

What is your professional background?

After receiving a Ph.D. in Zoology from the University of Minnesota, I completed a post-doctoral fellowship in immunoparasitology at the Naval Medical Research Institute in Bethesda, Maryland. Then I returned to the Midwest and earned a D.V.M. at the University of Minnesota, College of Veterinary Medicine. After graduation, I joined the faculty in the Department of Veterinary Pathology, College of Veterinary Medicine at Iowa State University (ISU) in Ames, where I've been employed as a veterinary parasitologist for the past 25 years.

How did you become interested in the topic of BVDV as a research project?

I was a member of the ARF Board of Directors at the time when BVDV infection of alpacas first started to show up on the radar screen. When ARF sent out a request for proposals on BVDV in alpacas, Dr. En-Min Zhou, who was an immunologist with the ISU Veterinary Diagnostic Laboratory, became interested in writing a proposal. However, as a native of China, he didn't know much about the U.S. alpaca industry. He contacted me as a local alpaca breeder in order to obtain more information. To make a long story short, I resigned from the ARF BOD to avoid any conflict of interest and submitted a proposal to ARF as a co-investigator with Dr. Zhou and Dr. Annette O'Connor, who is a veterinary epidemiologist at ISU.

The major goal of this study was to test 200 randomly-selected U.S. alpaca herds for antibodies against BVDV in order to determine how frequently alpacas are infected with the virus, and to see if there is a relationship between potential risk factors and the presence of antibodies.

Have you worked on similar research projects for ARF?

No, I haven't done any similar studies for ARF. However, I have done a few other epidemiological studies, including one on the prevalence of meningeal worm infections in white-tailed deer in central Iowa and another on the prevalence of Eimeria macusaniensis in Midwestern camelids. I did a project for the Morris Animal Foundation that demonstrated the efficacy of injectable ivermectin in preventing meningeal worm infection in llamas and described the pharmacokinetics of oral, injectable, and pour-on ivermectin in llamas. Other projects include evaluating Toxoplasma gondii infection in pregnant llamas; the comparative efficacy of injectable, pour-on, and oral ivermectin preparations against gastrointestinal nematodes in camelids; the cross-transmission of E. macusaniensis among camelid species; and characterization of the normal bacterial flora of the prepuce in male llamas and alpacas.

How have you been involved in the alpaca community?

I was first exposed to camelids early in my career at ISU more than 20 years ago. While most people gravitate to camelids because they are such attractive animals, for me it all started with a dead body and some fecal samples. I had to perform a necropsy on a guanaco cria belonging to Dr. Bill Franklin. Although I knew nothing about guanacos at the time, I was intrigued. Then in 1988, I found some E. macusaniensis oocysts while examining feces from a group of research guanacos at ISU. This interesting parasite piqued my curiosity and led to the purchase of my first llama just so I could infect him with "E. mac." Having no prior experience with llamas, I tried to learn everything I could about them, and shortly thereafter, decided to share what I had learned by developing an elective course in camelid medicine. This course has been offered as part of the ISU veterinary curriculum for the past 17 years. One thing led to another and before long I had a small llama research and teaching herd at ISU plus my own personal herd of llamas to which I added alpacas in 1993. I've served on the AOBA Board of Directors as well as the AOBA-ARI Government and Industry Relations Committee and the Ethics and Protest Committee. I was AOBA's representative to the U.S. Animal Health Association for five years, served on the ARF Board of Directors, represented ARF on the Lama Medical Research Group and at Camelid Community, and am currently co-chairperson of the USDA Camelid Identification Working Group. I've also been an invited speaker on various camelid topics at numerous state, regional, national, and international producer and veterinary meetings.

Is there anything else you would like to mention?

I'd like to sincerely thank the alpaca owners who participated in our study and those who contribute financial support to the Alpaca Research Foundation and the Morris Animal Foundation. These two groups fund the majority of peer-reviewed research on camelids in the U.S., and I would encourage continued support of their efforts.

Shana Aberle grew up in the alpaca industry, attending shows and conferences, with her parents, Steven and Rose Ann Knoblock, owners of Knoblock's Prairie Ranch. She and her sister, Tasha Knoblock, own Prairie Legacy, LLC, which produces Pac-a-Nutrition® alpaca crunch. She can be reached at (785) 284-2589.