Equine Viral Arteritis

USDA APHIS VS Career Services Program
Program Diseases Training Module

Written by: Glenda Dvorak, DVM, MS, MPH
Iowa State University, College of Veterinary Medicine

Reviewed by: Tim Cordes, DVM
Senior Staff Veterinarian, National Animal Health
USDA-APHIS-VS

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This course is designed to provide updated information on the major domestic diseases for which Veterinary Services (VS) has program responsibility. It will provide information on surveillance, disease control and eradication for these diseases. It will also give an overview of the duties of a field Veterinary Medical Officer (VMO) as a support worker of VS animal disease programs and how they interact with other units in APHIS.

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1. DISEASE INFORMATION

a. Agent
Equine viral arteritis (EVA) is an acute, contagious viral disease that affects members of the equine family, particularly horses. It is caused by an Arterivirus, the equine arteritis virus (EAV), which is an enveloped RNA virus. The virus localizes in the vascular endothelium of smaller blood vessel and in the epithelium of certain tissues, particularly the adrenal, seminiferous tubules, thyroid and liver.1,2 The virus is not particularly resistant outside of the host and is sensitive to sunlight, high temperatures, various disinfectants and lipid solvents. Viability of the virus is preserved at refrigeration or freezing temperatures and EAV can remain infective in frozen semen for many years.3

b. Transmission
Transmission of EAV can occur in a number of ways, however, the most common routes are respiratory and venereal transmission. Aerosol transmission is the principal means of spread of infection among horses closely congregated, such as at racetracks, shows, and sales.2 Transfer of EAV via respiratory secretions occurs through direct contact with exhaled infective droplets.4 Large quantities of EAV are shed into the respiratory tract of acutely infected horses and shedding can persist for up to 16 days.1,3,4

EVA can also be spread by venereal transmission through semen of an acute or chronically infected (carrier) stallion or through the reproductive tract secretions of an acutely infected mare.1,4 This is frequently the mode for dissemination of the virus on breeding farms.2,3 Venereal spread of EVA can also occur through the use of infective fresh-cooled or frozen semen.1,4

Stallions may also develop a carrier state for EAV. Mares, geldings, or sexually immature colts will naturally eliminate the virus and develop a strong immunity to reinfection after contracting the disease.1,4 On the contrary, infected stallions are very likely to become long-term carriers and reservoirs of the virus. These animals show no clinical signs of the disease or demonstrate any adverse effects on fertility. The carrier state is only identified by antibody positive blood. The virus is harbored in the accessory sex glands (especially the ampullae of the vas deferens). Duration of virus persistence can vary greatly and ranges from several months to many years.1,3,4 The virus is shed constantly in the semen of carrier animals and transmitted solely by the venereal route. The carrier state has never been confirmed in stallions vaccinated with the current modified live-virus vaccine against EVA.1,4

Although mechanical spread of EAV can potentially occur (through virus-contaminated tack or equipment shared among horses, or hands or clothing of personnel handling the animals), it is thought to be of minor importance and occurs to a lesser extent than other modes of transmission.1,4

An infected pregnant mare, can transmit EAV across the placenta to the unborn foal. In such cases, the fetus, fetal fluids, placenta and placental fluids are plentiful sources of virus.1,3,4

c. Clinical Signs
EVA is principally a disease of the respiratory system that can affect horses of any age. Most horses develop no visible signs of the disease and are considered asymptptomatically infected. The clinical outcome of EVA is influenced by a variety of virus, host, and environmental factors.
Severity of disease is likely to be greater in very young or old horses, in debilitated animals, or those that are physically stressed.\textsuperscript{1,3}

The incubation period of EVA varies with the route of inoculation, but ranges from 2-14 days.\textsuperscript{1-4} It is typically shorter with aerosol exposure and longer when transmission occurs by the venereal route.\textsuperscript{3} Clinical signs can vary in range and severity. Affected animals may exhibit some or most of the following signs: fever of up to 5-9 days duration; anorexia; depression; and/or edema of the legs, scrotum, prepuce, or mammary glands. Less consistent signs include serous to mucoid nasal discharge; conjunctivitis; lacrimation; photophobia; supraorbital or periorbital edema; or an urticarial rash on the sides of the neck or head (can possibly be generalized).\textsuperscript{1-3}

Equine arteritis virus can also cause abortion in pregnant mares. This can occur late in the acute phase or early in the convalescent phase of infection. Abortion rates can vary from 10-50\% and can occur anytime from 3-10 months of gestation.\textsuperscript{1,2,4}

Stallions acutely affected with EVA may experience a period of temporary subfertility, which can last up to eight weeks. No long-term adverse effects on fertility have been reported.\textsuperscript{4} There is also no scientific evidence that mares infected with EAV experience any short- or long-term virus-related fertility problems.\textsuperscript{4} Horses in training can experience a period of impaired performance while acutely affected with the virus.\textsuperscript{1-4}

In the early veterinary literature, a severe disease similar to EVA was documented. Although a case-fatality rate of 40-60\% was reported in older horses, it is now been considered that this information refers to infection in horses with an experimentally derived variant of the EAV isolated in 1953.\textsuperscript{1,3,4} It does not reflect the type and severity of clinical disease observed in field outbreaks of EVA. Mortality is very infrequent and the vast majority of animals affected with EAV make total clinical recoveries.\textsuperscript{1,3,4} Interstitial pneumonia or pneumoenteritis can develop rapidly in neonatal foals (within 48-96 hours) and lead to death. This is seen mostly in foals congenitally infected with the virus.\textsuperscript{3,4}

When indicated, treatment of EVA cases is symptomatic or aimed at alleviating the severity of some of the clinical signs of disease (i.e., control of fever and reduction of dependent edema). Adequate rest during the recovery period is important.\textsuperscript{4} There is no successful treatment for young foals with EAV-related interstitial pneumonia or pneumoenteritis. Prophylactic administration of antibiotics is indicated in older foals acutely infected with EAV to counter possible secondary bacterial infection.\textsuperscript{3}

\textbf{d. Epidemiology}
EVA is distributed in various horse populations throughout the world. It has been reported from countries in North and South America, Europe, Africa, Asia, Australia and New Zealand.\textsuperscript{1,4} Although outbreaks are infrequent, their occurrence and the global distribution of EVA is greatly influenced by international movement of horses (i.e. racing, shows), carrier stallions and shipment of infective fresh-cooled or frozen semen.\textsuperscript{1,4} There are indications that the incidence of EVA has increased over the past 10-15 years. This may be due in part to greater industry awareness of the disease, more widely available diagnostic laboratory capability, and/or continued expansion in international trade of horses and semen.\textsuperscript{4}
The prevalence of EVA infection differs considerably among countries and among particular horse breeds. Standardbreds and some other Warmblood breeds have been found to have a higher seropositivity rate compared to that of Thoroughbreds and other breeds (i.e., Quarter Horses). However, they are not considered more susceptible.1,3,4

The first virologically confirmed outbreak of EVA in the world occurred on a Standardbred breeding farm in Ohio in 1953.1,3,4 In 1984, a large scale outbreak of EVA occurred on 41 Thoroughbred breeding farms in Kentucky. Two very important findings were discovered about EVA: (1) the efficiency with which an acutely infected stallion could venereally transmit the virus, and (2) the high carrier rate that immediately occurred in stallions following natural infection with the virus.5

e. Diagnosis
It is not possible to establish a diagnosis of EVA based solely of the nature and extent of clinical signs. Diseases than can clinically mimic EVA include equine herpesvirus 1 (rhinopnemonitis), influenza, purpura hemorrhagica, equine infectious anemia, urticaria and certain plant toxicoses. Additionally, exotic equine diseases such as African horse sickness should be considered.4,5

The only definitive means of diagnosing EVA is by laboratory testing. In acutely infected horses, virus isolation or detection methods can be used for nasal or conjunctival secretions, blood, semen, aborted fetal tissue, placental tissue or fetal fluids. Additionally, paired serum samples can be tested for the presence of antibodies to EAV. Samples should be obtained 3-4 weeks apart.1,4

The serum neutralization and virus isolation test are the official laboratory procedures currently employed for the diagnosis of EAV infection.6 Testing procedures should be conducted according to methods for international trade prescribed by the OIE7 and are described in the OIE Manual of Standards for diagnostic tests and vaccines.6,8 The manual is available at http://www.oie.int/eng/normes/mmanual/A_summary.htm.

Virus detection in the laboratory is inexpensive, safe and provides timely results. USDA-APHIS-VS maintains a list of laboratories approved to conduct serological testing for EAV. The proficiency of approved laboratories is subjected to periodic evaluation by NVSL. The current list of approved laboratories can be viewed at http://www.aphis.usda.gov/vs/nvsl/labcertification.htm. As of November 2003, 18 labs were nationally approved to perform diagnostic testing for EVA. The OIE (World Organization of Animal Health) reference laboratory for EVA in North America is located at the Gluck Equine Research Center in Kentucky.

Diagnostic screening of stallions for the carrier state is also important. Initially it involves testing serum for EAV antibodies. Stallions testing positive (neutralizing antibody level or titer of 1:4 or greater) without any history of previous EVA vaccination should be considered a potential carrier of the virus.1-4 All antibody-positive non-vaccinated stallions should be screened for the carrier state by either (1) attempting detection of EAV in semen in the laboratory, or (2) subjecting them to a test-breeding program involving two seronegative mares and monitoring the mares for the development of serum antibodies to the virus up to 28 days after breeding.1-4 Testing can be attempted at any time before, during or after the breeding season since carrier
stallions shed EAV constantly in their semen. Semen collected for testing should contain the sperm-rich fraction of the ejaculate.\textsuperscript{1,3,4}

**f. Prevention and Control**

EVA is a very controllable disease through sound management practices and implementation of a selective vaccination program. Current control programs\textsuperscript{6,8} are focused primarily on restricting spread of the virus in breeding horse populations to (1) prevent outbreaks of EVA-related abortion and/or illness and (2) minimize the risk of establishment of the carrier state in stallions. Control involves minimizing or eliminating contact (direct or indirect) of infected horses or their secretions, excretions or tissues with susceptible horses. Specific preventative and control measures to help minimize the spread of EVA include:\textsuperscript{1,3,4}

1. Isolation of all new arrivals or any horses returning from other farms, sales, or racetracks for 3-4 weeks;
2. If possible, segregation of pregnant mares from other horses on the farm;
3. Blood-testing of all new breeding stallions for antibodies to EAV, prior to the start of each breeding season;
4. Laboratory testing of semen of any antibody-positive, non-vaccinated stallion to identify any carrier animals;
5. Annual vaccination of all noncarrier breeding stallions at least four weeks prior to the start of the breeding season;
6. Maintaining any EVA carrier stallion in physical isolation;
7. Observing strict hygienic precautions when breeding or collecting from carrier stallions;
8. Restricting breeding of EVA carrier stallions to only vaccinated mares or mares that have previously tested positive for naturally acquired antibodies to the virus;
9. Vaccinating EVA antibody-negative mares at least three weeks prior to breeding with a known carrier stallion or with virus-infective semen;
10. Isolating mares vaccinated for the first time against EVA from all but known EVA antibody-positive animals for three weeks. It is especially important to avoid contact between such mares and other pregnant mares, to which they can spread the virus by the respiratory route.

When dealing with a suspected outbreak of EVA, the following procedures are strongly recommended:

1. Promptly isolate all affected horses;
2. Seek laboratory confirmation of a diagnosis as soon as possible;
3. In the case of an abortion or death of a newborn foal, submit the placenta, fetus or foal to the nearest diagnostic laboratory\textsuperscript{6};
4. Disinfect any stalls, equipment or other potentially contaminated facilities;
5. Dispose of any bedding by composting in an area away from horses;
6. Wash down hindquarters and tail of any mare that has aborted and isolate her from other horses for four weeks;
7. Restrict movement of horses onto or off of the affected premises;
Suspend all breeding operations until the outbreak is over. Owners of mares on the affected premises should be notified.

Monitor all horses at weekly intervals. If no further cases, clinical or serological, occur for three consecutive weeks, the outbreak can be considered over and movement restrictions lifted.

Vaccinate all at-risk horses.

Precautions taken for mares artificially inseminated with EAV-containing semen are identical to those recommended for mares bred by live cover to carrier stallions.

1) Vaccination. Only one commercially available vaccine against EVA is available in North America. ARVAC® (Ft. Dodge Animal Health) is a safe, effective, modified live-virus vaccine containing a highly attenuated strain of EAV. The vaccine should be administered to stallions at least four weeks prior to the start of the breeding season. It is not recommended for use in pregnant mares or in foals less than six weeks of age, unless the risk for natural infection with EAV is high. Although protection afforded by vaccination is considered to last for several years, the USDA recommends that all vaccinated horses should receive yearly boosters to protect against infection and to prevent development of a carrier state in stallions. It is also strongly recommended that all immature male foals between 6-12 months of age be vaccinated against EVA to minimize, if not eliminate, the risk of becoming a carrier of the virus at a later date. Currently there are no control programs specifically directed at preventing the spread of EAV in non-breeding farm settings.

g. Public Health Consequences
EVA is not transmissible to humans. There is no public health risk for this disease.

h. Economic Impact
EVA can have economic consequences for both breeding and performance sectors of the horse industry. Direct financial losses resulting from outbreaks can lead to losses due to abortion, decreased commercial value of stallions persistently infected, reduced demand to breed to carrier stallions because of the added expense and inconvenience involved in vaccinating and isolating mares before and after breeding. Additionally export markets for carrier stallions or semen may be denied, as well as a reduced export market for others (i.e., mares, geldings). Additionally, an outbreak at a racetrack, equestrian event or horse show can cause direct financial losses through disruption of training schedules, reduced race or competition entries or events.

2. HISTORY OF EQUINE VIRAL ARTERITIS AND CONTROL PROGRAM

More than a century ago, a disease fitting the clinical description of what we now call EVA was reported in the European veterinary literature. However, the virus was not isolated from horses in the U.S. until 1953 during an epidemic of abortions and respiratory disease in Ohio. The most recent EVA epidemic occurred in 1984 in Kentucky on a number of Thoroughbred breeding farms. Since then EVA has significantly impacted international trade of horses and equine semen. The import control policies of most countries currently deny entry to carrier stallions and EAV-infective semen because of the associated disease risks. Currently, the U.S. is the only major horse-breeding country without an import control policy for EVA.
of any restrictions on the import of carrier stallions or EAV-infective semen into the U.S. has greatly increased both the likelihood of the virus becoming more widely disseminated in the U.S. equine population and the risk of economically damaging outbreaks of EVA.  

Traditionally, the U.S. horse industry has attached relatively little significance to this disease. Efforts to achieve a greater level of control over the spread of EAV within the U.S. equine population have been hampered by insufficient awareness of the disease and its potential economic consequences within the horse industry.  

In September 1996, the American Horse Council formed a working group to develop guidelines for breeding a mare to an EAV-shedding stallion. The working group included representatives from a number of equine breed organizations, as well as individuals from State and Federal agencies. The overall goal was to develop a voluntary, industry-driven protocol to assist breeders in preventing the spread of EVA. The guidelines, released in August 1997, were subsequently endorsed by the American Association of Equine Practitioners (AAEP) and the United States Animal Health Association (USAHA). 

Despite these guidelines, decreased awareness was revealed from the findings of USDA’s National Animal Health Monitoring Systems’ (NAHMS) Equine ’98 Study of EVA in the equine industry. The study distributed questionnaires to 1,136 equine operations in 28 states. Additionally, 837 operations in 25 states contributed to serology testing for EAV antibodies. Over 7,000 horses were tested overall. From the questionnaire, 59% of equine operators had never heard of EVA. The percentage was lower for operations with 20 or more horses or those involved with racing or breeding. A high percentage of individuals responding to that survey had little knowledge about the reasons or methods for controlling EVA. Seroprevalence to EAV was 2% in unvaccinated horses with 8% of operations having one or more horse seropositive to EAV.  

On September 20, 2000, USDA-APHIS published an Advance Notice of Proposed Rulemaking and Request for Comments (ANPR) in the Federal Register regarding options for the development of a regulatory program for EVA in horses within the United States. The options proposed ranged from programs that were strictly industry driven to highly federally regulated to a combination of the two. Comments were received until November 20, 2000. The ANPR received 79 comments with the majority favoring a voluntary control program for EVA.

3. CURRENT CONTROL PROGRAM

EVA is a reportable disease in many states and some states do have an EVA control program in place. Education and increasing awareness is an important part of reducing the prevalence and spread of EVA. The USDA-APHIS-VS, in cooperation with the University of Kentucky and EQUUS Magazine, developed an EVA video and booklet information packet titled “Equine Viral Arteritis: A Manageable Problem”. These materials are useful for educating equine industry personnel about EVA.

Following requests for more education on EVA, four regional EVA interactive videoconferences were presented in FY2002 for Area Veterinarians-In-Charge (AVIC) and State Veterinarians, as well as, academic, research, private practice, and VS veterinarians.
Effective September 1, 2003, USDA-APHIS released “Equine Viral Arteritis: Uniform Methods and Rules (UM&R)”, which contains the minimum standards for detecting, controlling and preventing EVA as well as minimum EVA requirements for intrastate and interstate movement of equines. The information is similar to guidelines for breeding mares to carrier stallions, which the American Horse Council developed and distributed in 1997. A brief period of review and comment from the industry has been requested by February 1, 2004.

a. Diagnostic Tests
Serum neutralization and virus isolation are the official laboratory procedures currently employed for diagnosis of EAV infection.

b. Testing Procedures
   1) Pre-breeding. Stallions should be tested for antibodies to EAV before breeding. If found seronegative, the stallion should be vaccinated for EVA and not used for breeding within 28 days after vaccination. Annual revaccinations against EVA should follow.
   2) Seropositive stallions. If a stallion tests positive for antibodies to EAV the following is recommended:
      1) Owners should provide documentation that the animal was seronegative for antibodies to EAV before being vaccinated;
      2) If the owner cannot document that the antibody titer was the result of vaccination, either,
         • semen from the stallion should be tested by viral isolation at an approved laboratory, or,
         • two EAV negative mares can be bred by the stallion and then tested 28 days after breeding for the presence of EAV antibodies. If both mares test negative, the stallion will qualify for breeding;
      3) The farm’s veterinarian must document all vaccinations and submit an EVA vaccination certificate to the State Veterinarian within seven days of the vaccination date;
      4) When a shedding stallion is approved for breeding by the State Veterinarian, various steps should then be taken to inform the mare owner or agent and prevent the spread of EAV. Details are listed in the EVA UM&R.

c. Outbreak Procedures
When an EVA outbreak is suspected, the attending veterinarian should immediately contact the State Veterinarian. If the disease is not a reportable disease in such state, a self-imposed quarantine should be implemented.

   1) Farm Outbreaks. For a quarantine to maximally be effective, immediate restrictions must be imposed on the movement of all horses associated with the premises. Actions listed in the Prevention and control section should be taken immediately.
   2) Racetrack Outbreaks. Measures taken in the event of an EVA outbreak at a racetrack, equestrian event or horse show are broadly similar to those recommended for breeding farm outbreaks. Major emphasis should be placed on isolating animals, restricting movement (in and out of facility) and vaccinating at risk animals.
d. Movement of Stallions and Semen

1) **Official health certificate.** All equines entering a State from another State or from another country should be accompanied by an official health certificate stating that they are free from clinical signs of an infectious disease (which by inference includes EVA).6

2) **Seropositive stallions or EAV-infected semen.** Breeding stallions and equine semen entering a State from another State or another country should be tested for EAV within 90 days of entry. Stallions must be tested serologically and seropositive stallions must have their semen tested by virus isolation.6

3) **Permit.** All carrier stallions or EAV-infective semen should be moved only with a permit issued by the State Veterinarian. All parties associated with movement should be fully aware that the animal or semen can be quarantined at any time.6

4) **Regulations.** States should develop regulations allowing for the interstate movement of carrier stallions and EAV-infected semen.

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4. **ROLES OF THE VETERINARY MEDICAL OFFICER (VMO) IN THE PROGRAM**

The U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) Veterinary Services (VS) program provides the equine industry with EVA diagnostic and surveillance support.

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5. **ROLE OF OTHER AGENCIES, STATES AND INDUSTRY**

**a. Recommendations for Breed Registries**

Breed registries should take a leadership role in raising awareness and educating their members about EAV. Breed registries should publish articles that explain the importance of EVA, how it is transmitted and prevented. Additionally, they should promote safe breeding practices. An informational video and CD about EVA is available from USDA-APHIS.6

Finally, breed registries should consider requiring mandatory testing of all breeding stallions as a condition of registration. Although voluntary adherence is helpful and desirable, it may not address all problems. A registry can prevent many problems by using its influence and control to require testing as a condition of registration. This should include publishing the EVA status of all active breeding stallions as well as requiring annual testing and vaccinations (when appropriate). Breed registries should also work with local horse groups and government authorities to develop State, national and import regulations.6
6. REFERENCES


