Equine Viral Arteritis: How Significant a Threat does the Disease Represent Today?

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Overview

- Salient features of causal agent, epidemiology of disease and clinical outcomes of infection
- National awareness of EVA
- Clinical and economic significance of EVA
- 1984 disease event
- Unpredictability of disease
- Variability in virus pathogenicity
- The carrier stallion
- Control programs for EVA
Equine Viral Arteritis

Definition –

► Equine viral arteritis or EVA is a contagious disease of equids so named because of its characteristic vascular pathology.

► Causal agent is equine arteritis virus (EAV).

► First etiologically and pathologically defined in 1953, following an outbreak of respiratory disease and abortion in Standardbreds near Bucyrus, Ohio, USA.

► One of the 4 major equine viral respiratory pathogens.
Equine Arteritis Virus:
Distribution & Prevalence of Infection

- Virus present in horse populations in many countries.
- Prevalence of infection can vary widely among various breeds in the same country and between different countries.
Dissemination of Equine Arteritis Virus

Means of spread -

► Movement of horses incubating the infection or subacutely infected with the virus.

► Importation of carrier stallions - highly important.

► Shipment of virus-infective semen - highly important.

► Possibly through embryos from an EAV infected mare - this remains to be confirmed.
Outbreaks of Equine Viral Arteritis vis-à-vis Distribution of Equine Arteritis Virus

- Confirmed outbreaks of the disease not reflective of widespread distribution of etiologic agent.
- Majority of confirmed cases of infection continue to be asymptomatic.
- Virus infrequently diagnosed as a cause of abortion or illness/death in young foals.
- Occurrences at racetracks, horse shows or sales very sporadic.
Increase in Reported Outbreaks of Equine Viral Arteritis Since 1984

Likely reasons –

► Greater awareness and reporting of disease.

► Bona fide increased incidence of EVA.

► Improved laboratory capability in diagnosing disease.

► Increased frequency of national / international movement of carrier stallions / shipment of infective semen.
Outcomes of Natural Infection with Equine Arteritis Virus

► Subclinical or inapparent infection in the vast majority of cases.

► Sporadic occurrence of clinical disease of varying severity.

► Possibility of abortion in pregnant mares.

► Very infrequently, fatal respiratory or pneumo-enteric syndrome in young foals.
### Clinical Signs - Equine Viral Arteritis (EVA)

<table>
<thead>
<tr>
<th>Depression</th>
<th>Limb edema</th>
<th>Nasal discharge</th>
<th>Periorbital edema / conjunctivitis</th>
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</thead>
<tbody>
<tr>
<td>Depression</td>
<td>Edema, mammary glands</td>
<td>Epiphora</td>
<td>Urticarial rash</td>
</tr>
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- **Depression**
- **Limb edema**
- **Nasal discharge**
- **Periorbital edema / conjunctivitis**

**Images:**
- Horse in pasture
- Horse's limbs
- Horse's nose
- Horse's eye
- Horse's mammary glands
- Horse's eye
- Horse's scrotum
Clinical Outcome of Equine Viral Arteritis (EVA)

► Regardless of severity of clinical signs, natural cases invariably make complete clinical recoveries.

► Mortality in naturally acquired infection is an infrequent occurrence in foals a few days to several months of age, and a very rare outcome in older horses.
Potential Consequences of Equine Arteritis Virus Infection for Breeding Populations

- Abortion.
- Fulminant pneumonia / pneumo-enteritis in congenitally infected neonatal foals and in foals up to 3 months of age.
- Temporary subfertility in stallions.
- Establishment of the carrier state in the stallion.
Equine Arteritis Virus (EAV) Related Abortions

- EAV infrequently isolated from cases of equine abortion.
- Abortion may supervene after clinical or inapparent infection of the mare.
- Abortion occurs late in the acute phase of the infection or in early convalescence.
- Mares at risk of aborting from 2 to over 11 months of gestation.
- Abortion rates range from <10% to >70%.
- Fetus is usually partly autolysed on expulsion.
- Virus specific lesions uncommonly present in the fetus.
- EAV can usually be isolated from/detected in placenta and a range of fetal fluids and tissues.
Equine Viral Arteritis Related Abortion

Points to emphasise –

► Abortion not a sequel to breeding a mare with semen from a carrier stallion.

► It occurs in mares already pregnant at time of exposure to the virus.

► Exposure most often by the respiratory route, through direct contact with an acutely infected animal.

► Usual source an unprotected mare very recently bred with infective semen and co-mingled with pregnant mare(s).

► Less frequently, through pasture contact with placenta and placental fluids of an aborted fetus of a cohort mare.
Equine Viral Arteritis in the Stallion

**Effects on semen quality –**

- Decrease in % of normal sperm, commencing week 1 after infection, reaching a nadir by week 7, and resuming pre-exposure levels by week 16.

- Decrease in % of motile sperm, reaching a low by week 8, resuming normal levels by week 14.

- Decrease in sperm concentration, reaching a low by week 8, resuming normal levels by week 16.
National Awareness of EVA

- Lack of awareness in certain sectors of horse industry.

- Relative lack of significance attached to disease.

- Infrequency of past occurrences of EVA.
Clinical and Economic Significance of EVA

- Outbreaks largely recorded in breeding populations.

- Infrequently responsible for outbreaks at performance events.
  - Potential for spread to breeding farms and racetracks.
Three Landmark Occurrences of EVA

► 1984 widespread event involving TB breeding farms in Kentucky.

► 1993 extensive outbreak at Arlington Park Racetrack, Chicago, IL.

► 2006 multistate occurrence of EVA: spread from New Mexico to 18 states and 2 provinces in Canada.
Equine Viral Arteritis

1984 –

► A "watershed year" with respect to perceived importance of EVA, following widespread occurrence on TB breeding farms in Kentucky, USA.

► Marked a "sea-change" in how both equine community and regulatory authorities worldwide viewed potential economic significance of disease.
Equine Viral Arteritis

Principal industry concerns -

► Risk of spread of the disease through national / international movement of horses and shipment of semen.

► Potential to cause extensive outbreaks of abortion in naive populations of pregnant mares.

► Risk of illness and death in foals up to a few months of age.

► Likelihood of establishment of the carrier state in a variable percentage of stallions.
Impact on trade –

- Near Draconian measures swiftly instituted by many countries requiring the screening of imported horses for this infection.

- Over the intervening years, import-control policies of major horse-breeding countries have relaxed somewhat.

- To this day, EVA remains one of the most internationally regulated equine diseases.
Significant Findings to Emerge from 1984 Epidemic of EVA in Kentucky

- Venereal transmission by acutely infected stallions of considerable importance in spread of the disease.
- Virologic confirmation of the carrier state in a variable percentage of clinically recovered stallions.
- Virus strain involved confirmed abortigenic in subsequent experimental studies.
1993

Veterinary clinic in northwest IL

Arlington Park racetrack, IL

Hawthorne Park racetrack, IL

breeding farm in WI

Sportman's Park racetrack, IL

Hazel Park racetrack, MI

breeding farm in MI

Churchill Downs racetrack, KY

Ak-Sar-Ben racetrack, NE

Prairie Meadows racetrack, IA
States Potentially Exposed to EAV Infection in 2006 through Shipment of Semen / Movement of Mares

Diagnostically confirmed outbreaks of EVA.
Circumstantial evidence of EAV infection (high titers & linked epidemic).
No evidence of EAV infection.
Modes of Transmission of EAV

► **Acutely infected horse**: respiratory, venereal, congenital (pregnant mare), and indirectly, through virus contaminated fomites.

  - Respiratory spread very important in outbreaks on breeding farms, equestrian events, veterinary clinics, sales, etc., and wherever horses come into close contact.

► **Chronically infected stallion**: venereal, solely by direct sexual contact or by AI with infective semen or indirectly, through virus contaminated fomites.
Unpredictability of EVA Outbreaks

► Unpredictability and infrequency of occurrences characteristic of the disease.

► Contrast with patterns of disease of other 3 major equine viral respiratory pathogens.
Variability in Viral Pathogenicity and other Phenotypic Characteristics of EAV
Phenotypic Variation among Strains of EVA

- Only one major serotype (Bucyrus strain) known to exist.
- Strains can vary in pathogenicity and antigenicity.
- Clinical responses to infection with field strains of EAV can be non-existent, mild, moderate or severe.
- Compared to equine herpesvirus-1, not all EAV strains appear abortigenic. (McCollum, 1970; McCollum & Timoney, 1998.)
Phenotypic Variation among Strains of EVA (cont.)


▶ Variation not associated with horizontal / vertical virus transmission during an EVA outbreak. (Balasuriya *et al.*, 1999).

▶ Tropism for CD3+ T lymphocytes and CD14+ monocytes influenced by *in vitro* passage history of virus. (Go *et al.*, 2010).
Could be considered an Andromeda strain of EAV.

Experimentally derived from a 1953 fetal lung isolate by serial passage (8x) in horses.

Highly velogenic; can kill 50 – 60% of experimentally infected horses.

No naturally occurring strains of EAV of equivalent pathogenicity.
Equine Arteritis Virus

The carrier state –

- Not infrequent occurrence as a sequel to natural infection in the stallion.
- Unconfirmed in the mare, gelding or sexually immature colt.
- Establishment and maintenance of the carrier state is testosterone-dependent.
Significance of the Carrier Stallion in the Epidemiology of EVA

- Principal reservoir of the virus between outbreaks of the disease.
- Very important role in equine arteritis virus transmission on breeding farms.
- Source of genetic and phenotypic diversity among strains of the virus.
Characteristics of Stallions Persistently Infected with EAV

► Clinically normal.
► Seropositive (SN titre ≥ 1:4) for antibodies to the virus.
► Constant semen shedders of the virus.
► Predilection sites of virus persistence - certain of the accessory sex glands, especially the ampulla of the vas deferens.
► No adverse effect on stallion’s fertility.
Transmission of EAV by the Carrier Stallion

- Infection spread solely by the venereal route.
- No evidence of spread by the respiratory or other non-venereal routes.
- Transmission rates of 85 - 100% in susceptible mares bred naturally or by A.I. with virus infective semen.
The Carrier Stallion

- Carrier stallions and infective semen frequently implicated in international spread of EAV.
- Increased risk of virus dissemination from expansion in global trade in cryopreserved semen.
- Repeated instances where EVA outbreaks in USA traced back to imported carrier stallions/infective semen.
EVA: “A Manageable Disease”

Focus of prevention & control programs –

- Primarily directed at restricting viral spread in breeding populations to:
  - minimise risk of virus related abortion.
  - prevent establishment of the carrier state in the stallion.

- Due to infrequent occurrence, little justification for developing a program to prevent EVA at performance events.
Commercial Vaccine Against EVA

Modified live virus vaccine (ARVAC®, Zoetis):

► Used in the USA and Canada since 1985, and on a very limited scale in New Zealand.

► Safe and highly effective for use in stallions and non-pregnant mares.

► Does not persist in the reproductive tract of the stallion.

► Not a DIVA vaccine.
No established control program currently exists.

Only two states, Kentucky and New York, have mandated control programs for their respective TB breeding industries.

USDA, APHIS, VS developed and published a Uniform Methods and Rules (UM&R) in 2004.

(continued)
Informational Resources on EVA Prevention and Control Programs

► “EVA (Equine Viral Arteritis), A Manageable Problem” Video/DVD and informational booklet, USDA, APHIS, VS. 2001.


► AAEP Guidelines for Breeding a Mare to an Equine Arteritis Virus Shedding-Stallion. Last revised 2008.

► AAEP Biosecurity Guidelines for Control of Venereally Transmitted Diseases. 2011.
Equine Viral Arteritis
Uniform Methods and Rules, Effective April 19, 2004
American Association of Equine Practitioners (AAEP)

Biosecurity Guidelines for Control of Venereally Transmitted Diseases

Introduction
These guidelines are intended to serve as recommendations. These guidelines are neither regulations nor directives for standard of care and should not be interpreted as such. It is the responsibility of attending veterinarians, through an appropriate veterinarian-client-patient relationship, to utilize relevant information to determine optimal management of the horses in their practice. It is incumbent on each individual practitioner to reach a decision on actions based on the circumstances of each unique situation and his or her professional experience. (See last page of guidelines for full disclaimer.)

Guidelines
Although these guidelines are primarily intended for the prevention and control of venereally transmitted diseases, they are also useful for control of other infectious diseases caused by viruses, bacteria and parasites. Other AAEP guidelines such as Infectious Disease Control Guidelines and Vaccination Guidelines are recommended reading for members. For this document, the term horse will be used to refer to all equids (horse, donkey, mule, and pony).

The emphasis of these guidelines is to control the transmission of the following disease agents:

- *Taylorella equigenitalis/asiigenitalis*; Contagious Equine Metritis Organism (CEMO)
- Equine arteritis virus (EAV)
- Equine herpesvirus-3 (EHV-3) or equine coital exanthema virus

Although not included in the foregoing list, mention should be made of *Trypanosoma equiperdum*, the cause of dourine that the United States has been free from for many years. Dourine has long been known to be a venereally transmitted disease of horses. Transmission of dourine takes place almost exclusively by coitus, especially from an infected stallion to a mare. While spread of the causal agent has not been confirmed by AI, this could potentially occur since *T. equiperdum* is present in seminal fluid.

American Association of Equine Practitioners (AAEP)

Guidelines for Breeding a Mare to an Equine Arteritis Virus Shedding-Stallion

Last revised 2008
Sources of Economic Loss Resulting from Equine Viral Arteritis / Equine Arteritis Virus Infection

- Outbreaks of EVA-related abortion and very infrequently, death in young foals.
- Denied export markets for carrier stallions, virus infective semen and for certain countries, any horse seropositive to EAV.
- Disruption of training schedules, reduced race entries and possibly card cancellations in racetrack outbreaks.
- Decreased marketability of carrier stallions and commercial demand to breed to them.
Should Equine Viral Arteritis be a Source of Continuing Concern for the Equine Industry?

Based on:

- increased risk of spread of the virus,
- greater frequency of disease outbreaks, and
- direct and indirect economic impact,

Equine viral arteritis should be of concern to the equine industry.