

GENETIC DISEASES ASSOCIATED WITH THE ARABIAN BREED – AN OVERVIEW

(information partially excerpted from “Caution and Knowledge” by the AHA Equine Stress, Research and Education Committee, published in the Aug/Sept 2007 issue of Modern Arabian Horse magazine)

Severe Combined Immunodeficiency Disorder (SCID): An affected foal is born with a severely weakened immune system. Because their natural defense system against infection is not functioning properly, by the time they are five months or so of age, they generally die of an opportunistic infection (such as pneumonia) or they are euthanized.

Cerebellar Abiotrophy (CA): The Purkinje cells in the brain’s cerebellum begin to die, resulting in a severe lack of coordination. The degree of severity can vary, but most affected individuals are euthanized before adulthood, due to the hazard they present to themselves and others.

An affected foal is usually born without clinical signs. However, as they begin to grow, the degeneration of the Purkinje cells begins. Clinical signs include a head tremor and severe incoordination, combined with an inability to accurately gauge distance. Additional signs include an exaggerated gait and when at rest, a wide-legged stance. Young horses with CA are also hyper-reactive and somewhat more prone to rearing than ordinary horses, with the frequent result that they lose their balance and fall. Clinical signs may not appear immediately, but are often first noticed at times when the foal is under close scrutiny, such as weaning.

CA is often mistakenly diagnosed as Wobbler’s Syndrome or as head trauma from an injury. Wobbler’s Syndrome is caused by compression of the spinal cord, due to malformation of the cervical vertebrae during growth, and can be diagnosed with the assistance of radiographs. Clinical signs can also be misdiagnosed as head trauma from an accident, because foals often injure themselves by falling over backwards or colliding with a fence. However, both conditions are quite different from CA and care should be taken to differentiate them. Although clinical signs and case history can lead to a diagnosis of CA, at this point in time, the only way to confirm such a diagnosis is to examine the brain tissue after euthanasia. [note: there is now an indirect DNA test available for CA – see next page for details]

Lavender Foal Syndrome (LFS) [also known as Coat Color Dilution Lethal (CCDL) or Dilute Lethal]: This is a neurological disorder thought to be caused by a brain lesion. An affected foal cannot stand at birth and usually has seizures. LFS foals are frequently born with a telltale diluted coat color that can make the hairs appear to be a dull lavender, a pinkish-brown or somewhat silvery. In many cases, the foal also had a difficult delivery. If the coat color is overlooked or not present, foals may be misdiagnosed as having neonatal maladjustment syndrome (known as “dummy” foals), due to a lack of oxygen from the dystocia. Foals are usually euthanized within a few days after birth.

Juvenile Epilepsy Syndrome (JES): Although not generally fatal, it can be disabling and there has been a suggested genetic link to Lavender Foal Syndrome. Affected foals are born normal, but will have periodic epileptic seizures, beginning anywhere from 2 days to 6 months after birth. Between seizures, they appear normal. Treatment can include the use of traditional anti-seizure medications, which may reduce the severity of the clinical signs. Affected individuals usually outgrow the condition between 12 and 18 months.

Guttural Pouch Tympany (GPT): Occurs in horses ranging from birth to 1 year of age and is more common in fillies than in colts. It is thought to be genetic in Arabians, possibly polygenic inheritance, but more study is needed. Foals are born with a defect that causes the pharyngeal orifice of the Eustachian tube to act like a one-way valve. Air can get in, but it cannot get out. The affected guttural pouch is distended with air and forms a characteristic nonpainful swelling. Breathing is noisy in severely affected animals. Diagnosis is based on clinical signs and radiographic examination of the skull. Medical management with NSAID and antimicrobial therapy can treat upper respiratory tract inflammation. Surgical intervention is needed to correct the malformation of the guttural pouch opening to provide a route for air in the abnormal guttural pouch to pass to the normal side and be expelled into the pharynx. Foals that are successfully treated may grow up to have fully useful lives.

Occipito-Atlanto-Axial Malformation (OAAM): This is a condition where the cervical vertebrae fuse together in the neck and at the base of the skull, causing compression and injury to the spinal cord. Affected foals are often unable to stand and nurse, but in other cases, the clinical signs may not become noticeable for several weeks. Clinical signs range from mild incoordination to the paralysis of both front and rear legs. This is the only cervical spinal cord disorder seen in horses less than 1 month of age, and a radiograph can assist in diagnosing the condition.

It is critical for breeders to support the ability of modern science to locate the genes that cause these conditions. Developing genetic tests is a must!

How are these diseases inherited?

SCID is known to be an autosomal recessive trait and breeding experiments conducted at the UC Davis Veterinary Genetics Laboratory indicate that CA is also an autosomal recessive trait. While the genetic nature of LFS and OAAM are not yet fully understood, some researchers have suggested that these are also autosomal recessive traits. "Autosomal" means the trait is not sex linked, and "recessive" means that in order for a foal to be affected, it must have 2 copies of the mutated allele, receiving one copy from each parent. [Note: research updates indicate LFS is an autosomal recessive trait and a direct DNA test has recently been developed for LFS]

The mode of inheritance for JES has not yet been determined, but research indicates it is an autosomal dominant trait. A "dominant" trait means that an affected foal only needs to inherit one copy of the mutated allele to show clinical signs. Recent research updates for GPT indicate there is some sex linkage (fillies more likely to be affected than colts) and it is a polygenic trait (multiple genes involved).

Does linebreeding or inbreeding "cause" these diseases?

No. However, the more the gene pool is reduced by closely breeding related horses; if carriers are present, the frequency of the mutated allele(s) has the potential to increase in the population.

Is there any bloodline of Arabian horse more or less likely to have genetic conditions?

No, all bloodlines in the breed have the potential to carry genetic disorders (e.g. SCID and CA have appeared in virtually all modern major bloodline groups and appear to be distributed throughout the breeding population). Also, while LFS is often associated with horses of Egyptian breeding, it has been identified in other breeding groups.

Did one horse or bloodline "cause" these diseases? Aren't these diseases a sign of "impure" breeding?

No and No. Cellular mutations can occur every time a cell divides; usually they have little to no effect. However, sometimes these mutations do end up altering a cell's function. In addition, while some historical animals are very likely to have been carriers (based on pedigree analysis of get or grandget who produced affected foals), there is anecdotal evidence that at least some of these conditions appeared even in desert bred Arabians. To quote the late Dr. Ann Bowling: *"Deleterious mutations that occur in purebred breeds are usually chance "hitch-hikers" in highly successful breeding lines, otherwise, the homozygous genotypes that produce the problem conditions would be so rarely encountered as to be overlooked or written-off as problems with unknown causes."*

Can't we eliminate genetic diseases by not breeding known carriers?

Without a test, it is impossible to identify all carriers. Just because a horse has "so far" never produced an affected foal does not mean it is "clear." Because stallions can sire many offspring, they are more likely to eventually be revealed as a carrier. Mares, however, may be unrecognized carriers. Even if bred to a carrier stallion, statistical probability may mean that they never produce an affected foal. Thus, a recessive gene can be passed on for generations without an affected foal being born. The SCID and CA tests allow people to avoid ever breeding an affected animal, and allow breeders to make an informed choice to breed or not breed a carrier, as they may choose.

Further, by removing all known carriers from the breeding population, the already limited Arabian gene pool would become even more limited and the breed could lose some highly valued bloodlines. In addition, a less-diverse breeding population may actually allow other genetic conditions to become more widely distributed. The success of SCID testing indicates that if known carriers are bred, with careful, selective breeding and testing of offspring, even carrier lines can be "cleared" of the gene.

Are tests available to determine carriers?

SCID testing is available through FOAL – through January 2010 cost is \$70/test for the 1st 100 orders placed, \$84/test thereafter: *Arabian F.O.A.L. Association* - <http://www.foal.org/user/orderkit.pdf>

CA testing (indirect DNA test) is available through the UC Davis Veterinary Genetics Lab for \$50/test:

Order online at: <http://www.vgl.ucdavis.edu/services/CA.php>

For information on CA research contact: Dr. Cecilia Penedo - mctorrespenedo@ucdavis.edu, phone: 530-752-7460

Additional information on research:

Lavender Foal Syndrome – Cornell University
Dr. Samantha A. Brooks - equinegenetics@cornell.edu
phone: 607-220-6698 or 607-254-8217
details on new LFS DNA test available in the near future

Juvenile Epilepsy Syndrome – UC Davis
Dr. Monica Aleman - mr Aleman@ucdavis.edu
phone: 530-752-1170 or 530-752-7267

Guttural Pouch Tympany - University of Veterinary Medicine Hannover, Germany
Alexandra Zeitz - alexandra.zeitz@tiho-hannover.de - phone: 011-49-511-953-8869

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