

Mules and HYPP: Can genetic disorders in horses (HYPP) be expressed in hybrid crosses (mules and hinnies) and cause similar symptoms that are found in horses?

An Interview with veterinarian, Dr. Lari Stokes, Columbia, SC
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I was recently reading one of my favorite horse magazines, The Horse when I ran across an article on “Genetic Diseases in Horses.” As I read through the article and all of the different disorders that can plague horses it made me think if our mules ever encounter any of these problems being half a horse. One such disorder known as HYPP or Hyperkalemic periodic paralysis is linked to an infamous quarter horse named Impressive. HYPP can be defined as a muscle disorder that can result in an increase in levels of potassium which can cause the muscles to twitch, paralysis and even death (common among horses that carry the genotype HH). The gene is dominant meaning if a horse carries at least one H (H- capitalized to express dominance) can exhibit signs of this muscle disorder (King, 28, 30).

Can this genetic disorder (HYPP) found in horses of Impressive bloodlines be found and expressed (meaning show up phenotypically or physically) in a hybrid cross such as a mule, where hybrid vigor, the genetic term used to describe a hybrid cross’ genetic ability to inherent the best traits of each species, like in mules their strength and endurance from the donkey but quickness from the horse? Dr. Lari Stokes a graduate of the University of Georgia’s College of Veterinary Medicine, has been trying to find answers to such questions by investigating on her own, “if mules can carry and express the gene for HYPP?” She has raised a mule out of an Impressive mare that has the heterozygous genotype (Hh). She assumed the mule could have a 50% chance of carrying the gene due to the fact the dam (mother) was a carrier and the genetic disorder is not linked or carried by the jack (hh - homozygous recessive genotype). T

	H	<i>h</i>
<i>h</i>	Hh	<i>hh</i>
<i>h</i>	Hh	<i>hh</i>

Table 1. **Mule’s chances of HYPP**

The Jack’s genotype is found on the side, hh, and the mare carrying the “H” gene is found on the top.

By using a simple table such as the above table, called the Punnet Square, one can figure that 50% of the mules will carry the “H” gene and 50% will not carry the “H” from this mating. Each square is worth 25% to make a total of 100%.

The University of California at Davis has developed a DNA test for identifying horses that carry the HYPP gene(s). Dr. Stokes’ took a hair sample from her mule and sent it to UC Davis to know for certain if the mule carried the gene. The test concluded that indeed her mule did inherit the H gene meaning he carries the gene but will the gene be expressed (the second big question)? In horses with even one “H” gene the muscle

disorders can occur. But in the mule that's a cross between two species and inherits different numbers of chromosomes from each species (32 from the horse and 31 from the donkey) the entire chromosomes **set does not** share information. It is said that only 19 of the 31 pairs are similar and can correspond or transfer information, so does this mean the mule is safe from the muscle tremors and paralysis or not? Again, further research is needed to help answer this very important question.

Dr. Stokes did take her mule to the University of Georgia Vet School to conduct a muscle comparison on her mule and a mule not known to carry the "H" gene called an **EMG** study. When her mule was compared to the other mule under this test her mule's muscles seemed to be **slightly** abnormal. However, **since her mule was the only abnormal that has been tested** this test was not conclusive that her mule carrying the "H" gene for a muscle disorder did have abnormal muscling or would display signs of HYPP. Again, more comparisons of mules carrying the "H" gene need to be tested with mules that do not carry the gene for the test to be more conclusive or suggestive in terms of the musculature of the affected mule vs. a normal mule. Another test is available in order to measure the effects of HYPP in mules. This test, **called a potassium challenge**, would require Dr. Stokes inserting a catheter into her mule and **infusing** him with potassium. The mule would either display signs of muscle disorder or not. **This test is a very definitive test but unfortunately can result in the death of the animal.**

As you can see many questions still need answers. Mules just like horses that carry the gene for HYPP may need special treatment such as a special diet low in potassium. A huge increase in potassium in these affected animals affects the **voltage gated sodium channels** and too much potassium is released into the blood stream causing the muscle disorder to some extent including possible death. It is suggested to feed animals with HYPP low amounts of potassium feed sources like beet pulp, corn, oats, barley, vegetable oil and some commercial feed companies can provide you with the potassium level of their feed if you ask. Also, it's recommended to avoid feeding your HYPP animal alfalfa hay, molasses, and wheat bran (King, 31).

If you have a mule(s) or a hinny(s) that are out of a mare(s) with Impressive bloodlines and would like to help improve the long eared industry please contact Dr. **Lari Stokes** at larihullsto@aol.com. She is primarily interested in testing more mules that are out of mares or stallions (if a hinny) that carry the "H" gene and then ideally further explore the chances of mules carrying HYPP **expressing** the gene (meaning will they have paralysis or muscle tremors, etc.). **These become very important questions to ask because in the next 10 or so years AQHA is going ban registry of positive foals. If positive mules can be shown to carry the gene but NOT exhibit symptoms, this could be an excellent place for these positive mares to go. The mule, since it is sterile, offer a unique option for the HYPP positive mares, if a mule foal is produced that is positive we know that the gene cannot be passed on to another generation. However, if the mule is shown to express the HYPP gene then all efforts should be made to be sure that NO mules are produced from these positive mares.** I think Dr. Stokes should be commended on her quest to help improve our industry. I hope that you will contact her if you have mules or hinnies out of such breeding. It's important to know so you can help prevent attacks as well as

providing more scientific data for our industry that is lacking in such information and research.

King, Marcia. Genetic Diseases, Who's at Risk? The Horse. 2005. October. Vol. XXII: 10. 28-31.