Physiological Characteristics and Management Implications of Working Senior Horses

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Introduction

Addressing health needs in the senior and geriatric horse is a unique issue, as not only are these animals considered companions, but many of them are expected to participate in demanding athletics. It has been estimated that between 7 and 15% of the equine population in the United States is over the age of 20 (Paradis, 2002), and of that population, 63% still participate in regular athletic activities and 10% are still competitive (Brasnahan & Paradis, 2003). This means that research related to the exercise physiology and fitness of senior working horses is not only relevant for a large portion of horse owners, but is economically significant in terms of services directed at this population. Unfortunately, before these services (such as preventative care and education) can be fully tailored to this subgroup, we need to understand the physiological changes that occur in these animals with respect to age as opposed to environment or illness. Much of our assumptions of the "aging phenotype" (McKeever, 2003) in horses are transposed from research done in human medicine, and are not currently confirmed with original research in horses. This review seeks to consolidate the current exercise physiology research that has been conducted specifically on the senior horse, and discuss the importance of these changes when managing and working with these older athletes to maintain performance with age.

The Senior Horse

One of the major challenges in defining physiological changes due to age is the large amount of variation created from other prominent factors such as genetics, health care, nutrition, environment, and athletic status (McKeever, 2003). The aging phenotype can be broadly defined as those changes that occur across all older animals, and which are not found in younger groups. Some of these changes have been identified well, such as the senior horse having a decreased

maximum heart rate, stroke volume, and VO_{2max} (Betros et al., 2002). Other documented factors are correlated with age, but aren't necessarily caused by aging as opposed to the common management and behavior of older horses. It has been well documented that older horses generally exhibit a muscular fiber composition change that is similar to younger horse atrophy models (McKeever, 2002). This change is characterized by loss of type I and IIa muscle fibers and increased amounts of IIx muscle (along with collagenous tissue) (McKeever, 2003). This switch from red to white muscle creates a less aerobic profile, which mirrors the loss of efficacy of oxygen dispersal during exercise. These correlations suggest that if we make management changes that will help prevent or recover from conditions that are secondary to aging (such as a lack of forced exercise) we can improve the performance of the horse regardless of age.

This shouldn't be a surprise, as the literature clearly shows that even at advanced age; the horse is a tremendous athlete. Even with an age related loss of VO_{2max}, old mares sit comfortably at 90mL/kg/min, a full 10 mL/kg/min higher than our best Olympians (McKeever, 2003). While owners will perceive horses as old at 20 years of age (Brosnahan & Paradis, 2003), they can actually be equated to a 57 year old person (Paradis, 2002), who if active is still very much capable of high athleticism. Even more impressive is the capacity to improve even at advanced age. Multiple studies have shown that light conditioning in senior horses can reverse the effects of aging due to compensatory mechanisms that aren't utilized in the young horse. While VO_{2max} does decline with age, conditioning can improve this value through several mechanisms. As max heart rate declines with age and cannot be increased, efficiency of blood dispersal is created through higher stroke volumes. It has been shown that senior horses can actually utilize low intensity exercise to improve cardiac output better than young or mature horses (Betros et al., 2002). To further adapt to VO_{2max} loss, senior horses also increase red blood cell and hemoglobin

counts in order to increase the oxygen carrying capacity of the blood (Paradis, 2002). Clearly, the horse is well equipped to extend its usefulness as long as possible; however, while management and training should work to take advantage of all these adaptations, of equal importance is an effort to slow the loss of aerobic and athletic ability in the first place.

Loss of Ability

While it's clear that the horse does have mechanisms to compensate for some aspects of the aging phenotype, there are still other physiological changes that are more detrimental and permanent, making prevention the focus instead of recovery. With the passing of time, animals require individualized plans for nutrition and medical care based primarily on previous conditions. Laminitis, for example, can be career ending, and is more prevalent in older horses, as well as hypothyroid disease and pulmonary issues stemming from lifetime infections or development of airway obstructions (Paradis, 2002).

The aging phenotype causes several permanent changes that directly impact the exercise capacity of the senior horse. One such change is a change in body conformation, resulting in two different body types, one characterized by obesity and the other a thin poor condition (Brosnahan, 2003). The obese condition is more common, and causes more problems as it reduces the amount of lean muscle available for exercise, and contributes to insulin related disease that can impact glucose mobilization before and after exercise (McKeever, 2003). Another change is the loss of the ability to effectively thermoregulate during exercise. McKeever (2003) showed that older horses reached higher body temperatures faster than young horses, and at lower intensities. This not only speeds up onset of fatigue, but also more quickly raises the heart rate of exercising seniors to provide enough blood flow to the skin for thermoregulation,

which causes them to produce more sweat than younger horses (McKeever, 2002). This increased perspiration can lead to dehydration following exercise, which is already exasperated in seniors by a reduced response to vasopressin, which increases water absorption during exercise, and encourages thirst post-exercise (McCreever, 2003).

The etiology of these changes isn't very clear; aging is often attributed to the slow decay of DNA that occurs over the lifetime of the animal. However, in horses and people there is a correlation with loss of muscle mass and condition as lower and lower levels of somatotropin (and subsequently Insulin Like Growth Factor 1, IGF-1) are produced by the pituitary (McKeever, 2003). Supplementation of somatotropin has shown to be helpful in people, and McKeever et al. (1998) examined chronic equine somatotropin (eST) supplementation in aged horses. They found that while supplementation increased nitrogen retention and improved appearance, it did not have the same effect on horses that it has had on people, and thus plays a smaller or complementary role in aging compared to other factors.

Management of Senior Working Horses

Using the information in the literature, we can now begin to examine management of senior working horses in order to understand and counteract the effects of aging. The most obvious change is to keep intermittently conditioning senior horses at low intensities to prevent loss of VO_{2max}, stimulate capillarization of muscle fibers, and take advantage of the compensation mechanisms the senior horse can employ to counteract the effects of aging. We can also avoid activities that while once may have been safe for the younger horse to participate fully in, may be more damaging to the older horse. One example would be western riding. Brosnahan & Paradis (2003) showed that old horses that participated in western riding were

more predisposed to lameness, suggesting that once at a senior age; it may be wise to designate that horse for a different discipline.

In terms of health and preventative care, we saw that during exercise there were concerns about hydration and thermoregulation in the senior horse. Management changes to overcome this could include having older horses work or compete with others of comparable age and take breaks more frequently, riders being more wary of hyperthermia as a concern in the competing senior horse, and utilizing a nutrition program that increases water intake in anticipation of dehydration during an event. As the senior horse also displays an average lower plasma volume compared to the young horse, stimulating drinking pre and post exercise would be ideal. We know that due to the lowered max heart rate and higher cardiac output we should also be careful when using pulse monitoring equipment to gauge fatigue, as the values for the senior horse will be very different than those of the fit young horse (Betros et al., 2002).

In terms of skeletal changes, a discussion on exercise in aged animals would be incomplete without mention of osteoarthritis. However, the details of the condition have been well studied, and are mostly independent of age when compared to use and patient history. In managing senior horses with osteoarthritis, regular low intensity exercise will help maintain range of motion in the affected joints (Malone, 2002). There is varied research on the effectiveness of glucosamine and chondroitin sulfate (Siciliano, 2002) to slow progression of the disease, but the vast amount of literature discussing therapy and treatments for osteoarthritis is beyond the scope of this paper.

Conclusion

While clearly there are large gaps between knowledge of human aging and horse aging, we conclude that there is enough literature available concerning the aging process on exercise to determine appropriate management plans for senior working horses. Given the systems they animals themselves have in place to compensate for the loss of exercise capacity, and the ability to improve through conditioning even at a great age, it is foreseeable that as we learn more of the potential of our senior horses, that this group's numbers will continue to grow. Thus, a continued need for research on aging exclusive to horses as a species will be necessary to keep up with both interest in the information itself and its market opportunities.

Literature Cited

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