Exercise and Rehabilitation of Older Horses

Kenneth Harrington McKeever, MS, PhD

KEYWORDS

• Aging • Horse • Physiologic function • Exercise capacity

KEY POINTS

- The population of older horses is increasing, with many of those animals performing various athletic activities into their 20s.
- Published studies have focused on the physiologic mechanisms associated with the onset of aging-induced decreases in physiologic function and exercise capacity in the horse.
- The information presented can be used as a guide for exercise prescriptions for the growing population of athletically active older equine athletes.

INTRODUCTION

In 1996, researchers conducted the first study that compared the physiologic markers of exercise capacity in young mature and old horses.[1] The old horses were all more than 20 years of age and, as expected, there was a substantial difference in maximal aerobic capacity and the amount of anaerobic work that the old horses could perform compared with the young mature horses.[1] An unexpected observation was that there was no increase of muscle enzyme levels in both groups of horses, suggesting no detrimental effect of the intense exercise on the old horses.[1] Questions arose out of that experiment, regarding the benefits of moderate exercise training for older horses that are sound and healthy. Aging seems to alter metabolic control, immune function, and endocrine function in horses, both at rest and following exercise.[2,3] Older horses may undergo significant changes in body composition, with some horses losing muscle mass and some becoming obese.[4–6] There are many changes associated with aging that can limit the ability to perform light or moderate exercise and the question

Disclosure: This work was supported by funds from New Jersey Agricultural Experiment Station and the Rutgers Equine Science Center.
Department of Animal Science, Equine Science Center, School of Environmental and Biological Sciences, Rutgers, the State University of New Jersey, 84 Lipman Drive, New Brunswick, NJ 08901-8525, USA
E-mail address: mckeever@aesop.rutgers.edu

Vet Clin Equine 32 (2016) 317–332
http://dx.doi.org/10.1016/j.cveq.2016.04.008 **vetequine.theclinics.com**
0749-0739/16/$ – see front matter

remains as to whether this is caused by inactivity or aging.[4–6] This article discusses how aging affects the systems important to any exercise activity, synthesizing information from exercise physiologists and veterinarians conducting basic and applied studies into a format that can serve as a guide for clinicians contemplating an exercise prescription for older horses.

AGE-RELATED CHANGES IN AEROBIC CAPACITY AND CARDIOVASCULAR FUNCTION

It is well known that, in humans, the ability to perform strenuous work decreases with age, both because of a decline in aerobic capacity and a decline in anaerobic power.[7,8] However, much debate exists in the literature as to how much of that decline is caused by physiologic aging versus disease process related to inactivity. Aging seems to have profound effects on the cardiovascular system, producing decreases in maximal heart rate (HR_{max}), changes in baroreceptor sensitivity, decreased vascular compliance, and hypertension in species such as rats, dogs, and humans.[9–11] These observations have led to a fine tuning of exercise prescription for older human athletes to prevent the adverse and potentially dangerous effects of excessive work.[7,12]

Both older humans and horses show a decline in maximal oxygen uptake ($V_{O_{2max}}$) and exercise capacity. McKeever and Malinowski[1] showed that submaximal oxygen consumption was similar in young and old horses subjected to an incremental exercise test. However, $V_{O_{2max}}$, was significantly lower in unfit horses more than 20 years old (~90 mL/kg/min) compared with unfit young horses less than 10 years old (~120 mL/kg/min). As expected, the amount of work needed to reach $V_{O_{2max}}$ was lower in the older horses.[1] That study also suggested that there was a decline in the capacity to tolerate high-intensity exercise because older horses fatigued at lower exercise intensities than young animals.[1]

In terms of physiologic age the older horses in the study mentioned earlier were analogous to humans, ranging from 60 to 78 years of age, but horses' innate aerobic capacity is vastly greater than in humans. A study of moderately fit, healthy, postmenopausal women reported maximal aerobic capacities averaging 22 mL/kg/min.[2,7] Elite, Olympic-caliber, human athletes typically have maximal aerobic capacities in the 60 to 80 mL/kg/min.[13] Elite fit horses have maximal rates of oxygen consumption more than 145 mL/kg/min. The older mares in the experiment mentioned earlier with an average $V_{O_{2max}}$ of 90 mL/kg/min were less than their fit equine counterparts, but still well above the levels reported for young, fit, elite human athletes.[1]

One benefit of having a greater aerobic capacity in younger horses was the delay in the need to increase the rate of anaerobic glycolysis to fuel higher intensity exercise.[1] Younger horses had to exercise harder before reaching the anaerobic threshold or the point where the onset of blood lactate accumulation is observed; a point marked by blood lactate concentration of ~4 mMol/L.[1,3] At this point there is a curvilinear increase in blood lactate concentration indicative that lactate production by the working muscles has greatly exceeded lactate use throughout the rest of the body.[3] This variable is important because the velocity to produce a blood lactate concentration of 4 mMol/L (V_{LA4}) coincides with changes in several important physiologic processes related to regulation of acid-base status as well as respiration. It is also considered an indicator of endurance capacity. The older horses reached the V_{LA4} at both a lower speed and at a lower relative work intensity.[3]

Mechanistically, the decline in $V_{O_{2max}}$ seems to be caused by central factors (heart) as well peripheral factors (muscle) that limit oxygen delivery and use.[14,15] This process