

Biology of Aging in Horses

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To begin with, we need to clarify some definitions in regard to aging. **Life span** is the maximum attainable survival time for a given species. This differs from **life expectancy**, which is the average observed years of expected life from birth. **Gerontology** is the science of all old age phenomena whether pathologic or normal. **Aging** occurs in all organisms if they live long enough. It is not a disease.

When we speak of age we also need to clarify what type of age we are speaking about – chronological age, biologic age or demographic age. Chronological age refers to an actual time lived, usually counted in years. Biologic age can be expressed as a % of maximal function. Aging in this sense would begin at the point at which peak physiologic functions begin to decline. Demographic age pertains to survivorship relative to a population. If 100 –75% of a population is still alive then the individual may be considered mature. If only 25-75% of the population is alive, then the individual is old. The individual would be very old if <25% of the population is surviving.

There are many theories on aging. The more prominent theories differ around the biologic level at which there is dysfunction. Some scientists believe that aging is programmed in the DNA of cells while others believe that aging of an organism is ascribed to decrements in the function of a key system such as the immune system. It is probably a combination of genetic determination with environmental stresses that accelerate or decelerate the process. The balance between our genes and the environment helps to determine our biologic age.

There are a few studies that touch on the demographics of aging in the horse. The National Animal Health Monitoring Systems (NAHMS) did a survey of 2,904 horse operations in 28 states surveying approximately 10,000 horses. In that study they found that 7.5% of the horses were \geq 20 years of age. Ponies had the highest % of over 20 years of age at 15.2%. Only 2.7% of the miniature horses were over 20. When asked what the most common cause of death in horses over 30 days of age, owners responded with “old age”.

The Hospital for Large Animals at Cummings School of Veterinary Medicine at Tufts University conducted a horse owner and equine practitioner survey in the Fall of 2007 that looked at the demographics of the equine population in New England. There are an estimated 98,000 horses in this region. The owner survey (329 respondents – approximately 1000 horses) suggested that 155 of the horses reported on were > 20 years of age (14% 20-29, 1% \geq 30). All responding veterinarians saw horse > 20 in their practices and most estimated their practices had between 1-20% older horses. 30% of veterinary practices said their older population made up 21-40% of their caseload.

Another study conducted by Williams in 2000 looked at the problems of 817 horses > 15 years of age presented for necropsy examination. Forty-six percent of the horses examined were ≥ 20 years of age, the rest being 15 –19. This study found a higher percentage of ponies in the > 30 age group. The oldest equine (pony) was 45 years of age and the oldest horse was 42 years of age. Problems were categorized by the system involved or as neoplasia. Gastrointestinal disease was prominent in the horses between age 15-24 but declined in the older group. The incidence of neoplasia appeared to increase, as the animals became older.

Studies conducted by Brosnahan and Paradis were conducted in New England looking at specific demographics of the older horse. The first study looked at the hospital population of horses ≥ 20 years of age over a span of 10 years (1989-1999). It was a retrospective study that looked at the reasons why an older horse might be presented to a tertiary medical facility. The second study consisted of a prospective survey of owners of horses ≥ 20 years of age. The survey investigated health issues of the non-hospitalized elderly equine, management practices and owner perceptions of aging and compared these findings to a young subset of horses. I will be referring to these studies during the course of the day as they relate to some of the problems that we will be looking at.

What do we know about aging and the horse?

When a horse is considered old? This is a relevant question for researchers because of the need to standardize our data. Some “geriatric” studies have been done on horses as young as 15. At Tufts we decided that 20 years of age was a good place to start. When we asked owners when they considered their horses as old at a mean age of 22, with signs of aging developing at 23. Age was considered a negative factor in the purchase of a horse at 16.5 years old.

Mauderly and Hahn suggest that a 25 year horse corresponds in age-related changes to a 71 year old human. The mean life span has been stated to be 25 years old. In the Tufts studies, the old horses ranged in age from 20 – 45. The mean ages for the studies were 24 for the hospitalized horses and 26 for the surveyed horses. Most of the horses were between the ages of 20-29 (85% of hospitalized; 73% of surveyed). The remainder of the animals were ≥ 30 years of age (15% of hospitalized; 27% of surveyed).

Is there a breed that has more longevity than others? More than 70 breeds were represented in the Tufts studies. The top 5 breeds that were seen included the Quarter horse, Thoroughbred, Appaloosa, Morgan and Arabian. It was felt that this reflected the normal distribution of breeds in our area as opposed to an actual longevity factor. The exception to this was the predominance of ponies in the old horses vs the young horses and the percentage of ponies increased significantly in the oldest group (≥ 30). This overrepresentation of ponies in the very old group is similar to a finding of a study that analyzed data from necropsy findings of 817 horse > 15 years of age. In that study,

ponies represented 33% of the equids ≥ 30 and only 3% of the equids from 15 -19 years of age.

Although ponies appear to live longer than horses, the reasons for this are not known. In studies of wound healing in ponies and horses, second-intention wound healing was significantly more rapid in ponies than in horses. It is possible that ponies are genetically more capable of responding to and repairing tissue damage.

What are some of the clinical signs of aging in the horse? As the horse begins to age one can expect to see changes in the animal's body. These may include a loss of the "top line" muscle mass so as to give the animal a sway back appearance. There is usually a graying of the haircoat, particularly around the face. Many times owners will remark that the animal has an abnormal shedding pattern in the spring. Owners may notice that there is an increase in their older horse's water consumption and that the stall is more wet with urine than it used to be. Musculoskeletal stiffness may be evident when the animal is first ridden. It may be hard to keep weight on the very old animal because of dental problems. When the animal eats you may note that he/she is dropping more food on the ground or that whole kernels of grain are passed through their digestive tract unchanged. You may detect a heart murmur that was not there when your horse was younger. The older brood mare will have more difficulty becoming pregnant.

Various studies have focused on these different aspects of aging in the horse. Following are a sample of the work that has been done.

Hematology

Aged horses have significantly increased RBC mean cell volume and mean cell hemoglobin as compared to younger horses. In aged humans this is associated with decreased serum folate and B12. Horses synthesize these elements in colon – this may indicate decreased ability to produce or absorb folate and/or B12.

The total lymphocyte count of the older horse is decreased over younger counterparts. Similar findings in humans are due to progressive decrease in B lymphocytes and CD4+ and CD8+ T lymphocytes. Implications are unclear but may reflect overall immunologic senescence in the aged individual.

Studies looking at arterial blood gases of the older horse suggest a difference when compared to younger animals. PaO₂, PaCO₂ were significantly lower in a group of 16 horses >20 years of age when compared to younger animals. Alveolar-arterial PO₂ gradient of the older animals was elevated. This may indicate a possible impairment of transfer of oxygen from the alveoli to the capillaries.

Endocrinology

Several interesting endocrinological studies have supplied us with information on the older horse. Despite the prevalence of pituitary dysfunction in the older horse, ACTH levels in normal aged mares are not significantly different from young mares. (McFarlane et al, AJVR, 1998) T4 and Insulin-like growth factor are significantly lower in mares (16-22) than mares (5-8). (Malinowski, et al J Anim Sci, 1996) Plasma renin activity, atrial natriuretic peptide, arginine vasopressin, aldosterone, and endothelin-1 levels are no different between young and old mares. (McKeever, Malinowski)

Orthopedics

You may begin to see stiffness in your elderly equine's gait. Arthritis is not uncommon in the older horse. It is believed that older horse cartilage is more brittle than that of a younger horse. Though GAG remain constant throughout life, there is an age-related decrease in proteoglycan size though the loss of GAG chains. (Platt et al, Equine Vet J, 1998) Older horses have also been found to have greater pentosidine crosslinks which may predispose older horses to osteochondral disease due to stiffer and more brittle cartilage. (Brama et al, AJVR, 1999)

Exercise studies have been conducted in the older horse. Older mares (22.0±0.4 years) had a lower (-24%) maximal aerobic capacity than young mares. (McKeever, Malinowski, AJVR, 1997)

Reproduction

Several differences have been noted in the fertility of the older mare. Mares > 19 years of age ovulate 2 weeks later in the spring than younger mares. (Vanderwall, Wood. Proc of AAEP, 1990) This was altered by feeding Equine Sr feed to older mares. (Carnevale et al, Proc of AAEP, 1996) Carnevale also found that older mares generally ovulate smaller follicles and have more multiple ovulations than younger mares.

Fertilization rates for young fertile and aged, sub fertile mare are similar at 80% but embryonic loss between fertilization and day 14 is 7-8 times higher in the aged sub fertile mares. The high rate of early embryonic loss in aged sub fertile mares may be due to inherent developmental defects in their embryos. (Brinsko et al, J Repro Fert, 1994)

Immunology in aging

In humans - immune function declines substantially with advancing age. There is some evidence that this may be true in the older horse as well. Japanese study showed a decrease in + titres to influenza after vaccination in older horses. (Goto, J Vet Med Sci, 1993) Older horses have a significantly lower proliferative response to mitogens than younger horses. (Horohov, AJVR, 1999) Horohov found that treadmill exercise decreased the lymphoproliferative response in younger horses but not in the older

animals. Chronic administration of equine somatotropin increased the granulocyte numbers in older mares. (Malinowski, *J Anim Sci*, 1997)

Aging is inevitable, whether in man or in the horse. Though research has been done on the older horse, it is really in its infancy. As we learn more about this aging process, effective interventions can be developed. We will never find the “Fountain of Youth” for these animals, but it is possible that they can be more comfortable and functional for more of their geriatric years.

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