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Clinical Consequences and Impacts of Equine Domestication

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Abstract

The contemporary domestic horse is the outcome of a significant evolutionary process termed domestication, which substantially altered the morphological, physiological, and behavioural characteristics of wild horses (Evin et al., 2015). This time-driven transformation has enhanced their use in human surroundings while also introducing new challenges and issues regarding their welfare and health (Ding, 2021). Veterinary professionals must understand the intricate relationships between changes resulting from domestication and their clinical ramifications, particularly with advanced surgical and medicinal management (Hall, 2011). This article aims to examine the evolutionary trajectory of horse domestication by elucidating the selective pressures that have shaped their current biological characteristics and behaviours. Furthermore, it will address the direct clinical implications of these domestication effects, to be more specific, their influence on general medical and surgical management options (Henry & Treanor, 2012). This article aims to point out how selective breeding for specific features, such as athleticism or docility, has inadvertently led to behavioural disorders and illness susceptibilities that necessitate specialised veterinary care (Cooper & Mason, 1998) (Tadich & Araya, 2010). This encompasses an examination of how domestication-induced alterations in microclimates and husbandry practices have influenced equine health, perhaps increasing their susceptibility to various diseases and impacting their immune systems (Capucchio et al., 2019).

Keywords: equine domestication, clinical consequences

EQUINE DOMESTICATION AND EVOLUTION

Horses were initially domesticated approximately 5,500 years ago from wild populations in the Eurasian steppes, signifying a pivotal moment in human history. Selective pressures for features that humans could manipulate resulted in intricate co-evolutionary dynamics between early human communities and wild horses (Veasey et al., 2011). Their initial domestication was likely primarily motivated by their utility as a food source and for transportation, subsequently expanding to encompass military applications, agriculture, and sports. The latter development of horseback riding significantly influenced human mobility, commerce, and military strategies. It also reinforced the status of horses in human society and resulted in more stringent selective breeding (Li et al., 2020) (Taylor et al., 2020).

The transition from wild to domestic forms resulted in significant genetic bottlenecks followed by diversity, explaining the multitude of breeds present today. This selective breeding, driven by human preferences and requirements, has significantly influenced the horse's genetic composition, leading to distinct features and predispositions for each breed (Stock et al., 2016). This process has resulted in a

reduction of total genetic diversity in domestic breeds relative to their wild forebears, while concurrently augmenting specific features by artificial selection (Parker et al., 2016). For instance, the selection of animals based on enhanced productivity and certain behavioural characteristics has been observed in many species, including horses. This may adversely impact health and welfare (Marle-Köster & Visser, 2021) (Knap & Doeschl-Wilson, 2020). This artificial selection has, for example, prioritised traits such as speed, strength, or certain coat colours, often at the expense of general health or natural disease resistance (Bronzo et al., 2020). The stringent selection for specific phenotypic qualities has often resulted in the simultaneous selection of unfavourable genetic predispositions, leading to breed-specific health problems that require expert therapeutic management (Raudsepp et al., 2019). These genetic alterations significantly influence the physiological functions, behavioural patterns, and susceptibility to diseases in contemporary horses. Studies on canine behaviour have shown that certain breed differences are highly heritable, underscoring the genetic basis of behavioural traits that may also apply to equines (MacLeant et al., 2019). The selecting pressures, while beneficial for specific human goals, have inherently caused genetic vulnerabilities in the equine population, necessitating a deeper understanding of these changes for effective veterinary intervention. This is particularly evident when considering its impact on surgery and medicine, as various breeds exhibit distinct anatomical variations and predispositions to diseases that necessitate tailored therapies. The stringent selection for production qualities in other domesticated animals, such as dairy cows, has demonstrated an inverse correlation with reproductive fitness, suggesting that analogous trade-offs may arise in horses due to similar selective pressures (Cushman et al., 2019).

Physiological and Anatomical Implications of Domestication

The extensive genetic and phenotypic changes brought about by domestication have led to notable physiological and anatomical modifications in horses, influencing their susceptibility to several health issues. These alterations, frequently associated with selective breeding for particular performance attributes or aesthetic characteristics, can predispose domesticated horses to musculoskeletal problems, metabolic syndromes, and modified digestive physiologies relative to their wild counterparts. Selective breeding for athletic prowess has resulted in musculoskeletal systems optimised for speed and power, however they may be more susceptible to injury and the onset of degenerative disorders under rigorous training.

The increasing incidence of lameness across all equestrian disciplines, a major factor contributing to attrition from the sport, is directly associated with these musculoskeletal changes, necessitating improved veterinary therapies (Rogers et al., 2012). These diseases often require sophisticated diagnostic imaging, novel surgical techniques, and extended rehabilitation programs, highlighting the direct clinical effects of skeletal changes generated by domestication (Jönsson et al., 2014). Alterations in bone density and morphology, induced by selective pressures favouring specific body types or gaits, may increase the susceptibility to fractures or developmental orthopaedic disorders (Nguyen et al., 2017) (Árnason et al., 1994). Domestication has exerted selection pressure on the equine digestive system, resulting in alterations that may influence nutrient utilisation and susceptibility to illness. The alterations are mostly attributable to modifications in dietary and feeding practices, transitioning from continuous grazing on diverse forages to the regular provision of highly processed concentrates. This alters the gut flora and the efficiency of food digestion in the body.

This dietary alteration frequently results in increased gastrointestinal issues, such as colic and stomach ulcers, which are significant concerns in contemporary equine treatment. Exercise-induced stress and elevated loading intensity substantially influence the composition of intestinal flora, crucial for host physiology and health, potentially leading to metabolic problems and gastrointestinal syndromes in performance horses (Zhang et al., 2022). Domestication has significantly altered the cerebral structure and behavioural range of horses, affecting their cognitive abilities, stress reactions, and general trainability in human settings. The neurobiological changes, shaped by the emphasis on docility and trainability, impact their welfare, behaviour in clinical settings, and susceptibility to stress-related diseases. The diminished fear responses and increased tolerance to human proximity, while beneficial for handling, may hide early signs of pain or discomfort, thereby delaying necessary veterinary care. Furthermore, altered stress reactions in domesticated horses, particularly under novel or restrictive situations common in clinical environments, can exacerbate physiological and behavioural symptoms, thereby complicating diagnosis and therapy (Young et al., 1989) (Hernández-Ávalos et al., 2021).

CLINICAL IMPLICATIONS OF DOMESTICATION

The selective pressures inherent in domestication have altered equine morphology and physiology, while also creating new clinical difficulties that necessitate specialist veterinary techniques and a deep understanding of these developed predispositions. One of the most significant clinical consequences of domestication is that horses are predisposed to and exhibit more severe musculoskeletal diseases. This is primarily due to selective breeding for physical prowess and alterations in living environment. This selective breeding has inadvertently enhanced specific anatomical features for particular sports, frequently compromising the horse's general structural integrity. This has resulted in an increased incidence of laminitis, osteoarthritis, and tendon/ligament injuries that require complex and prolonged treatment. The shift from nomadic grazing to restricted stabling, coupled with repetitive high-impact training, exerts undue stress on the horse musculoskeletal system, accelerating degenerative processes and increasing the likelihood of acute injuries. This necessitates the development of advanced diagnostic instruments, such as high-resolution imaging and gait analysis, with innovative treatment modalities, including regenerative medicine and tailored surgery, to address these prevalent issues (Ask et al., 2024). The domestication process, particularly through alterations in equine nutrition and care, has significantly impacted their digestive systems, increasing susceptibility to several gastrointestinal disorders. These encompass an elevated incidence of colic, stomach ulcers, and dysbiosis, which collectively constitute a significant portion of horse veterinary cases and necessitate meticulous nutritional control and medical intervention. The shift from a continuous forage diet to intermittent, substantial meals of energy-dense foods has markedly altered the horse gut microbiota, resulting in fermentative imbalances and increased endotoxin generation. This disruption of the delicate balance of the gut microbiota may lead to systemic inflammation and threaten general health, necessitating tailored dietary strategies and preventive measures (Gaillard et al., 2022). Domestication has significantly influenced equine reproduction and management, resulting in procedures that facilitate breeding but also introducing novel clinical challenges. Intensive breeding programs frequently employ assisted reproductive technology, hormonal modifications, and management techniques that significantly diverge from natural breeding practices. This increases the likelihood of infections in

the reproductive tract, premature embryo loss, and dystocia. The increasing application of artificial insemination and embryo transfer, which facilitates gene dissemination, necessitates vigilant veterinarian oversight to monitor reproductive health and prevent complications (Waqas et al., 2024). The transition to high-energy diets and reduced activity levels in domesticated horses has increased their susceptibility to metabolic diseases, akin to observations in other domesticated species, such as dairy cows (Sordillo, 2016) (Ceciliani et al., 2017). Equine Metabolic Syndrome and pituitary pars intermedia dysfunction exemplify this condition. They are characterised by insulin control issues, an increased risk of laminitis, and alterations in fat deposition. These illnesses necessitate intricate diagnosis protocols and prolonged therapy.

IMPACT ON CLINICAL AND SURGICAL MANAGEMENT

Domestication has led to distinctive physiological and behavioural changes, prompting substantial improvements in equine surgical procedures and clinical management protocols, especially in colic surgery and wound healing. The tendency of domesticated horses to experience colic, exacerbated by changes in diet and management, has prompted the development of advanced surgical techniques and stringent post-operative care regimens to improve survival rates (Trim & Shepard, 2015). The distinct physiological responses of domesticated horses to anaesthetic drugs, influenced by their neurological adaptations and susceptibility to stress, require tailored protocols to ensure patient safety and improve surgical outcomes (Layton et al., 2023). This entails meticulous planning of pre-anesthetic sedation, anaesthetic induction, maintenance, and recovery to mitigate the potential of adverse effects such as myopathy, neuropathy, and cardiovascular impairment, which may be exacerbated by their size and inherent flight response (Kynes et al., 2018). The elevated metabolic rates and distinct organ sensitivities in horses necessitate precise anaesthetic dosages and vigilant monitoring of vital signs, including blood gas and electrolyte levels, to prevent problems during and post-surgery (Beer & Waddell, 2015). Domestication has profoundly modified the immune responses and healing capacities of horses, making them particularly susceptible to issues during wound healing, such as excessive granulation tissue production and chronic infections (Theoret, 2005) (Mickelson et al., 2015). Chronic physical trauma and genetic predispositions exacerbate this vulnerability, altering wound healing and fostering a milieu that promotes the activation of latent infections or neoplastic changes (Martano et al., 2021). This necessitates the application of advanced wound care techniques, including specialist bandaging, topical treatments, and surgical debridement, to promote optimal healing and prevent long-term complications. The occurrence of certain pathogens in residential environments necessitates stringent antimicrobial stewardship and novel infection control techniques to reduce the danger of multidrug-resistant illnesses (Demetriou & Stein, 2011).

The transition from natural forage to controlled feeding practices has rendered domesticated horses highly reliant on specific nutritional kinds during illness or recovery. This indicates that accurate food formulations and feeding procedures are essential for enhancing therapeutic results (Carr & Holcombe, 2009). This entails not only sufficient caloric intake but also ensuring the appropriate quantities of macronutrients and micronutrients are available to support the immune system, facilitate tissue repair, and maintain overall metabolic health, particularly in individuals who are severely ill or have recently undergone surgery (Krueger et al., 2021). These factors are crucial for addressing equine colic, since targeted dietary

therapies can significantly influence recovery and prevent recurrence (Cheng et al., 2009).

In domesticated species, the anatomical and physiological alterations resulting from domestication, along with environmental stressors, necessitate advancements in surgical techniques and considerations about patient access, positioning, and management during operation. This is due to the augmented body bulk, altered skeletal architecture, and potential predispositions to illnesses such as laminitis. These modifications frequently require specialised instruments and adjusted surgical tables to ensure the safety and efficacy of procedures, particularly in orthopaedic surgeries or significant abdominal operations in larger breeds. The increased risk of post-operative complications, including ileus and incisional infections, in domesticated horses necessitates stringent post-operative monitoring and proactive management strategies to ensure successful recovery and reduce morbidity (Goldberg & Diegelmann, 2010) (Langlois, 2004) (Mickelson et al., 2015) (Fontenot & Neiffer, 2004). This involves meticulous attention to pain management, hydration treatment, and timely nutritional support to promote recovery and prevent secondary problems (Arbeloa et al., 2010) (Chung et al., 2013).

CONCLUSION AND DISCUSSION

The substantial impact of domestication on equine physiology and behaviour underscores the necessity for veterinary medicine to continuously advance and innovate treatment strategies to address the unique problems presented by modern horses. This involves integrating evolutionary ideas into modern veterinary procedures to improve the understanding of disease susceptibility and optimise treatment strategies. Future research should focus on employing genomic data to identify genetic markers associated with disease resistance and treatment effectiveness, hence enhancing personalised medicine approaches in equine health management. Additional exploration of the epigenetic alterations caused by domestication may reveal novel targets for treatment strategies and preventive approaches for prevalent equine diseases. Understanding these long-term changes is crucial for developing improved management plans to ensure the health and well-being of domesticated equids across diverse environments. An integrated One Health strategy that recognises the interconnectedness of human, animal, and environmental health is crucial for addressing complex challenges such as antibiotic resistance and ensuring sustainable horse welfare (Ajayi et al., 2024) (McEwen & Collignon, 2018)

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