

Copyright: The author/s
This work is licensed under a CC-BY 4.0 license
(*) Corresponding author
DOI: 10.20544/nhjsr.2026.601



VETERINARY FORENSICS - FORENSIC PATHOLOGY IN HIGH-VALUE INSURED HORSES: INJURIES AND POSTMORTEM CHANGES IN INSURANCE CLAIM CASES

Kristijan Salamovski (undergraduate student)*

University St. Kliment Ohridski Bitola, Faculty of Veterinary Medicine

kristijan.salamovski@uklo.edu.mk

Natasa Petrovska, PhD (mentor)

University St. Kliment Ohridski Bitola, Faculty of Veterinary Medicine

natasa.petrovska@uklo.edu.mk

ABSTRACT

High-value competition horses represent significant financial investments, making proper documentation and assessment of injuries particularly important in insurance claim cases. This review paper examines the pathological manifestations, forensic investigation methods and protective measures relevant to these situations. The review paper explores common pathological conditions affecting performance horses, diagnostic approaches for disease progression and forensic veterinary analysis techniques for characterising injury patterns. The distinction between accidental trauma and non-accidental injuries is examined through tissue damage patterns and the relationship between injuries and reported incidents. Emphasis is placed on systematic pathological examination methods, evidence collection and documentation processes used for insurance and legal contexts. Special attention is given to soring practices and their diagnostic indicators. Soring involves the intentional infliction of pain to a horse's legs or hooves in order to force the horse to perform an artificial, exaggerated gait. Understanding injury types and their postmortem characteristics helps veterinarians working with insurance companies and legal authorities provide accurate assessments. This supports animal welfare protection and objective evaluation in these cases.

Keywords: veterinary medicine, veterinary forensics, equine pathology, forensic investigation, insurance claims.

Introduction

The goal of this review paper is to explore the critical aspects of veterinary pathology in high-value equine breeds, with particular emphasis on forensic investigations, insurance considerations and economic implications. Understanding these elements is very important for veterinarians dealing with high-value competition horses and their unique medical and legal challenges.

The fundamental pathological conditions affecting premium horse breeds is of great importance, since there is a relationship between performance demands and physiological stress, leading to various pathological manifestations. Special attention is given to competition-related disorders, including stress-induced immunological changes,

musculoskeletal abnormalities and cardiovascular complications that can significantly impact a horse's performance and value.

The importance of proper documentation in legal proceedings is very high when examining high-value equine cases. The necessity of using sophisticated methodologies is very high in post-mortem examinations and evidence collection protocols, since they form the foundation of forensic veterinary investigations. These comprehensive approaches address both accidental injuries and intentional harm, particularly in cases where there may be intent in affecting competition outcomes.

1. Pathological manifestations in high value competition horses

High value competition horses frequently develop various pathological conditions due to the intense physical and psychological demands placed on their bodies. These manifestations primarily affect the immune, musculoskeletal and cardiovascular systems. They experience significant immune system alterations during intensive training and competition. Acute exercise stress can temporarily suppress immune function, particularly affecting lymphoproliferative responses. The activation of the hypothalamic-pituitary-adrenal axis during stress leads to increased cortisol levels, which can inhibit crucial immune functions. This immunosuppression makes these horses more susceptible to infections and it delays the recovery from injuries.

Osteoarthritis is one of the most prevalent conditions affecting performance horses, particularly involving the distal hock (tarsus), fetlock joints and cervical vertebrae. The development of these conditions stems from repetitive trauma and mechanical stress on joints during high-intensity training. Performance horses commonly develop ringbone, a degenerative condition affecting the bones and joints of lower limbs, especially in disciplines involving sharp turns and jumping.

Cardiac issues is another condition that is a significant concern in high-value horses. Atrial fibrillation appears as the most common and important pathological arrhythmia, typically resulting in higher than normal heart rates during exercise (40-60 beats/minute above normal), decreased cardiac output during high workloads and race time decreases of 15-30 seconds.

1.1 Pathological changes induced by training and exercise

Intensive training can lead to overtraining syndrome, which is characterised by poor performance and prolonged fatigue, weight loss and inappetence along with clinical signs of stress such as tachycardia and muscle tremors. The syndrome typically manifests after extended periods of high-intensity training, with clinical signs persisting for more than two weeks, despite rest. Competition events trigger significant physiological stress responses, particularly affecting white blood cell counts, packed cell volume and creatine kinase levels. These changes indicate substantial physiological strain during competitive events, potentially leading to long-term pathological consequences, if not properly managed.

Training induces radical changes in respiratory immunity, with research showing over 2000 differentially expressed genes affected by intense training. This can lead to activation of stress-associated pathways, alterations in metabolic pathways and higher prevalence of exercise-induced pulmonary hemorrhage. It is very important to know these pathological manifestations is crucial for veterinarians and trainers to implement appropriate preventive measures and treatment strategies, which would ensure the longevity and performance of high-value competition horses.

2. Pathological examination methods in forensic veterinary analysis

The forensic veterinary necropsy has become increasingly vital in investigating animal-related crimes and suspicious deaths in high-value equine cases. The systematic examination process requires specific protocols and a very careful and thorough documentation, to ensure evidence preservation for legal proceedings.

Modern diagnostic imaging plays a crucial role in forensic analysis of equine cases. Computed Tomography (CT) scanning has a very special role in forensic examination, since it provides a detailed three-dimensional visualisation of injuries and pathological conditions. The technology enables rapid capture of high-resolution cross-sectional images, particularly valuable for examining complex fractures, bone pathology, dental conditions, sinus problems, soft tissue injuries and vascular anomalies.

Standing CT systems now allow examination of sedated horses without general anesthesia, reducing risks while maintaining image quality. This advancement is particularly relevant when investigating potential intentional harm cases before competitions or races.

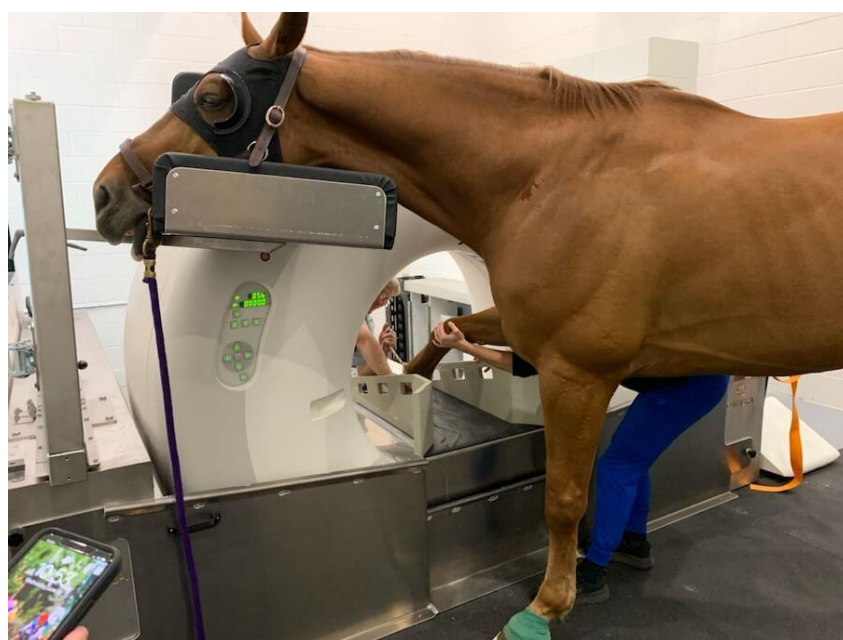


Photo 1 - Standing CT scan

<https://share.google/e0cCME90apIrhFFhy>

Determining the time since death is critical in equine forensic cases. Recent research has established protocols for post-mortem interval (PMI) estimation through tissue autolysis examination. The most reliable indicators are found in liver and muscle tissue changes. Liver tissue changes include hepatocyte individualisation, separation of bile duct epithelium and cellular degradation. Muscle tissue changes present as disruption of myofiber continuity, hypereosinophilia, loss of striation, fiber separation.

Temperature significantly influences the rate of tissue degradation, with changes being most predictable in liver and muscle tissue during the first 72 hours post-mortem.

2.1 Forensic sample collection and documentation requirements

Proper sample collection and preservation are essential for forensic analysis. Standard protocols require tissue samples of 100-200g, urine samples of 50mL, all available vitreous fluid, blood or serum samples of 5-10mL. Brain examination is particularly crucial in sudden

death cases, especially those involving potential toxicology concerns. A midsagittal cut allows preservation of one half for chemical analysis while the other is preserved in formalin.

Forensic veterinary examination demands comprehensive documentation such as detailed photographic evidence, written documentation of findings, proper chain-of-custody protocols, witness documentation, sample tracking forms, environmental condition records and injury pattern documentation.

The integration of advanced imaging techniques with traditional necropsy methods can enhance the ability to detect and document pathological conditions in forensic equine cases. This comprehensive approach can be particularly valuable when investigating suspicious deaths or potential abuse cases in high-value horses, where both criminal and insurance implications may be present. The thorough documentation and analysis support legal proceedings, insurance claims and criminal investigations involving valuable horses, ensuring justice and appropriate compensation in cases of intentional harm or negligence.

3. Types of harm and legal protection

In the competitive equestrian world, horses frequently fall victim to intentional harm driven by the pursuit of victory and financial gain. One particularly cruel practice is soring, which involves deliberately inflicting pain on horses' legs and hooves to create an exaggerated gait. This abusive technique is done by using caustic chemicals like diesel fuel, kerosene and mustard oil, to burn the skin, causing extreme suffering.



Photo 2 - Soring in horses

<https://share.google/WFwY6y9rWN0KOvwtM>

The administration of performance-enhancing substances represents another significant form of abuse in equestrian sports. Trainers and veterinarians sometimes resort to using various drugs to mask injuries or enhance performance, including muscle relaxants, sedatives and other potent pharmaceuticals. These substances can cause dangerous behavioral changes, exponentially increase blood volume and lead to fatal breakdowns during competitions.

From a forensic standpoint, intentional harm can be distinguished from accidental injuries through specific patterns. It is necessary to conduct an examination of the injury distribution, along with the severity and timing, to determine whether trauma has been

deliberately inflicted. Multiple injuries concentrated on the axial skeleton, including the skull, thorax and vertebral column, often indicate non-accidental injury.

Premeditated abuse in equestrian settings typically involves long-term planning and sophisticated methods of inflicting harm. This includes pressure shoeing, where the horse's hoof is cut almost to the quick before tightly nailing on a shoe, causing excruciating pain whenever weight is applied. Such calculated acts of cruelty often involve overcoming obstacles and elaborate preparation, suggesting higher degrees of intentional violence.

The physical signs of intentional harm in horses commonly manifest as multiple injuries inflicted over time. These may include burns from chemicals, grinding down of hooves, application of sharp objects and evidence of binding or physical restraint. Forensic investigations particularly focus on injury patterns that indicate prolonged maltreatment rather than sudden or instantaneous trauma.

Abused horses often exhibit distinctive behavioral changes that serve as crucial forensic indicators. These may include fear responses, moaning in pain while in stalls and dangerous handling behavior developed as a result of previous trauma. Professional trainers frequently encounter horses that have become hazardous to handle due to prior abuse, making them particularly challenging cases for equine veterinarians.

Conclusion

The forensic pathological examination of high-value insured horses is a complex intersection of veterinary medicine, legal requirements, economic considerations and animal welfare protection. These horses face substantial pathological challenges such as intensive training regimens, performance demands and unfortunately, intentional harm inflicted for competitive or financial advantage. The understanding of pathological manifestations, such as immunosuppression, musculoskeletal degenerative conditions and cardiovascular abnormalities, forms the essential foundation for accurate forensic assessment in cases involving insurance claims, suspected abuse or unexplained deaths.

The advancement of forensic veterinary techniques, such the integration of computed tomography scanning with necropsy protocols, has significantly enhanced the capability to document and differentiate accidental trauma from non-accidental injuries. The protocols for post-mortem interval estimation through tissue autolysis examination, with thorough and careful sample collection procedures and chain-of-custody documentation, ensures that forensic evidence maintains integrity throughout legal and insurance proceedings. They prove invaluable when investigating suspicious deaths in horses insured for substantial sums. The forensic veterinarian's ability to distinguish injury patterns, analyse trauma and correlate physical findings with reported incidents, directly impacts the outcomes of insurance claims.

The examination of intentional harm practices, particularly soring techniques, reveals the aspects of competitive equestrian sports where financial incentives override animal welfare concerns. The characteristic injury patterns associated with these abusive practices. The economic stakes are considerable, as high value racing and competition horses such as Thoroughbreds, Warmbloods and Arabian breeds have purchase prices from several hundred thousand to multiple million dollars, with their insurance valuations reflecting breeding potential, competition earnings and bloodline prestige.

As the equestrian industry continues to evolve, with increasing financial investments in high value animals and heightened scrutiny of training practices, the role of forensic veterinary pathology is only going to grow in importance, demanding continued refinement of investigative techniques, maintenance of rigorous professional standards and commitment to both scientific accuracy and animal welfare advocacy in all cases involving these magnificent and valuable animals.

LITERATURE

1. Thompson, Graham. 2025. "11 Most Common Injuries in English Sport Horses: Risk Factors, Treatment & Prevention | Mad Barn." Mad Barn Canada. October 14, 2025. <https://madbarn.ca/english-sport-horse-injuries/>
2. Virginia B. Reef Dvm, Dacvim, "The Effect of Cardiovascular Abnormalities on Performance (Proceedings)." Dvm360 - Veterinary News, Veterinarian Pet Care and Medicine Expertise, April 1, 2009. <https://www.dvm360.com/view/effect-cardiovascular-abnormalities-performance-proceedings>
3. Munsterman, Amelia S. 2024. "Overtraining Syndrome in Horses." MSD Veterinary Manual. May 2024. <https://www.msdsvetmanual.com/metabolic-disorders/fatigue-and-exercise-in-horses/overtraining-syndrome-in-horses>
4. Huangsaeksri, Onjira, Kanokpan Sanigavatee, Chanoknun Poochipakorn, Thita Wonghanchao, Mona Yalong, Khunanont Thongcham, Chanikarn Srirattanamongkol, et al. 2024. "Physiological Stress Responses in Horses Participating in Novice Endurance Rides." *Heliyon* 10 (11): e31874. <https://doi.org/10.1016/j.heliyon.2024.e31874>
5. Karagianni, Anna E., Dominic Kurian, Eugenio Cillán-Garcia, Samantha L. Eaton, Thomas M. Wishart and R. Scott Pirie. 2022. "Training Associated Alterations in Equine Respiratory Immunity Using a Multiomics Comparative Approach." *Scientific Reports* 12 (1): 427. <https://doi.org/10.1038/s41598-021-04137-3>
6. Brownlie, H. W. Brooks and R. Munro. 2016. "The Veterinary Forensic Necropsy." *Veterinary Pathology* 53 (5): 919–28. <https://doi.org/10.1177/0300985816655851>.
7. Takenaka, Celina Seiko, Cintia Navarro Alves De Souza and Claudia Momo. 2023. "Case Studies and Technical Aspects of the Forensic Necropsy of Exhumed Companion Animals." *Forensic Science International* 345 (February): 111624. <https://doi.org/10.1016/j.forsciint.2023.111624>
8. "Diagnostic Imaging, Video Endoscopy and Pathology." 2022. University of Melbourne Equine Centre <https://equinecentre.unimelb.edu.au/equine-services/diagnostic-imaging,-video-endoscopy-and-pathology>
9. Keadle, Tammie Lee. n.d. "The Effects of Exercise Stress on Equine Immune Function." LSU Scholarly Repository. https://repository.lsu.edu/gradschool_disstheses/5442/
10. Arfuso, Francesca, Maria Rizzo, Claudia Giannetto, Elisabetta Giudice, Giuseppe Piccione, Francesco Fazio, Roberta Cirincione, Giovanni Cassata and Luca Cicero. 2023. "Inflammatory-like Status and Acute Stress Response in Horses After Road Transport." *Scientific Reports* 13 (1): 9858. <https://doi.org/10.1038/s41598-023-37069-1>
11. "Advancing Equine Diagnostic Imaging: An Overview of Vision CT - Hallmarq Veterinary Imaging." Hallmarq Veterinary Imaging. February 23, 2024. <https://hallmarq.net/2024/02/23/advancing-equine-diagnostic-imaging-an-overview-of-the-vision-ct-system/>
12. "Diagnostic Imaging | Bell Equine Veterinary Clinic, Kent." 2025. Bell Equine. 2025. <https://bellequine.co.uk/our-veterinary-services/diagnostic-imaging>
13. Nanny Wenzlow, Dan Neal, Adam W Stern, Dhani Prakoso, Junjie J Liu, Gretchen H Delcambre, Sally Beachboard and Maureen T Long. 2021. "Feasibility of Using Tissue Autolysis to Estimate the Postmortem Interval in Horses." *Journal of Veterinary Diagnostic Investigation* 33 (5): 825–33. <https://doi.org/10.1177/10406387211021865>
14. "Collapse and Sudden Death." *Veterian Key*. August 11, 2016. <https://veteriankey.com/collapse-and-sudden-death/>.
15. "What Is Horse Soring?" 2018. Humane World for Animals. <https://www.humaneworld.org/en/resources/what-horse-soring>
16. "New Regs to Rein in Racehorse Abuse; USDA Proposes Potential HPA Upgrade." n.d. Animal Welfare Institute. <https://awionline.org/awi-quarterly/fall-2023/new-regs-rein-racehorse-abuse-usda-proposes-potential-hpa-upgrade>
17. "Drug Use | PETA." <https://www.peta.org/issues/animals-in-entertainment/horse-racing-2/horse-racing-industry-cruelty/drugs/>.
18. Smith, Kyle J., 2018, "Racing to the Lab: Issues and Solutions for Abolishing Performance-Enhancing Drug Abuse in Horse Racing," Seton Hall University School of Law, Student Scholarship, Seton Hall Law eRepository, https://scholarship.shu.edu/cgi/viewcontent.cgi?article=2080&context=student_scholarship

19. Baillie, Katherine Unger. 2018. "Veterinary Experts Work to Stay Ahead of Equine Doping." Penn Today, May 3, 2018. <https://penntoday.upenn.edu/news/veterinary-experts-work-stay-ahead-equine-doping>
20. Staff, Paulick Report. 2023. "Accident or Abuse? New Veterinary Science Could Tell the Difference." Paulick Report | Latest News and Commentary From the Horse Racing and Equine World, March 25, 2015 <https://paulickreport.com/horse-care-category/accident-or-intentional-new-veterinary-science-could-tell-the-difference>
21. Bartelink, Eric J., Shannon Clinkinbeard, Crystal Spessard, Aoife Kilmartin and William L. Spangler. 2021. "Documenting Non-accidental Injury Patterns in a Dog Abuse Investigation: A Collaborative Approach Between Forensic Anthropology and Veterinary Pathology." Journal of Forensic Sciences 67 (2): 756–65. <https://doi.org/10.1111/1556-4029.14948>
22. Lesté-Lasserre, Christa, MA. 2024. "Traumatic Horse Training: Can You Spot Abuse?" The Horse. May 30, 2024. <https://thehorse.com/176132/traumatic-horse-training-can-you-spot-abuse/>