REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 24, No. 2 (2023)
http://www.veterinaria.org
Article Received: 09 April 2023; Revised: 26 May 2023; Accepted: 12 June 2023

An Analysis of Managing Stress Response in Horses to Prevent Laminitis

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Abstract

Horses can suffer from the complex and painful condition of Laminitis. Laminitis is caused by various predisposing conditions, although the precise etiology is yet understood. The innate stress response includes substances such as cortisol, histamine, and serum T4 were found to be elevated, which may be the root of the issue or a contributing component. The amount of stress hormones present in Laminitis is largely unknown. To measure stress response variables in laminitic horses while comparing with control horses and horses with Gastrointestinal (GI) disorders. A prospective study was conducted on 40 adult horses brought in for clinical Laminitis, GI anomalies, or non-medical issues. On admission at the hospital, blood was obtained from the horses, and they were sorted into the relevant disease groups (healthy, GI disease, and Laminitis). The levels of serum cortisol, thyroid hormone, plasma histamine, and plasma endogenous adrenocorticotrophic hormone (ACTH) were measured in the samples. Horses with GI disorders and Laminitis have dramatically different levels of stress hormones. Comparing Laminitis to GI illness and control horses, laminitis horses had the highest plasma histamine levels. Compared to horses in good health, animals' Laminitis and gastrointestinal disease showed higher plasma eACTH levels. GI illness in horses had greater serum cortisol levels than in laminitis horses or control horses. Compared to Laminitis and non-laminitis horses, Serum T4 levels were decreased in diseased GI systems in horses. Both plasma histamine and eACTH levels were comparatively higher in laminitis horses. Comparing laminitis horses to healthy horses, serum T4 and cortisol amounts were not significantly different. There must be research to ascertain the impact of stress-related horse sickness caused by hormones.

Keywords: Adrenocorticotropic hormone, histamine, gastrointestinal diseases, and hormones.

Introduction

Laminitis is an extremely worrying and frequently disabling illness that affects horses worldwide. It is characterized by swelling and harm to the delicate laminae of the hoof, which can cause excruciating pain, lameness, and long-term effects on the horse's general health and soundness. Laminitis has many underlying causes, including several triggers and underlying conditions, and can manifest in both acute and chronic forms. Horses with The greatest risk factors for developing Laminitis are underlying endocrinopathy, sepsis/Systemic Inflammatory Responses Syndrome, use of poisonous foods like black walnut, or excessive unilateral carrying of the burden on a supporting limb (1). Laminitis can be brought on by a variety of things, such as dietary modifications, metabolic conditions like equine metabolic syndrome (EMS) or insulin resistance, hormonal imbalances, excessive weight bearing on one limb (supporting limb laminitis), systemic illnesses, prolonged exposure to lush pastures, trauma, and even some medications. Effective management and prevention of Laminitis depend on recognizing predisposing factors and understanding underlying causes (2). Horse

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stress reactivity has been studied concerning several management aspects and personality qualities. For instance, a lack of social interaction has been associated with alterations in the physiology and behavior of stress. Reduced forage intake or pasture time was linked to stereotypes and signs of chronic stress when feeding habits were examined. Additionally, it has been shown that participating in equestrian contests increases sympathoadrenal activity and activates the HPA axis right after the event (3). There is currently no evidence linking these previously recorded hormone concentrations to Laminitis. The same is valid for other similar endogenous substances, like thyroid hormone (T4), whose levels are known to decline in several illnesses. In addition to being a key facilitator of inflammation, histamine has also been linked to stress responses in plasma levels connected to Laminitis in horses and other species (4). Stress hormones have seldom been examined in genuine clinical instances of Laminitis (5). As a result, they examined a range of horses with laminitis, horses with gastrointestinal issues, and horses without the condition in order to identify stress variables associated with horse laminitis. They expected horses to have gastrointestinal problems, and Laminitis might resemble the physiological symptoms of stress. But they expected that compared to GI horse's problems or controls, clinically laminitic horses would have a different stress hormone profile.
The remaining articles are described in the sections that follow. In section 2, related works are displayed; in section 3, the methods and materials used; in section 4, the findings are presented; and in section 5, the study's conclusion is covered.

Related Works

The study (6) aimed to assess the effectiveness of SGLT2i ertugliflozin in treating Laminitis and hyperinsulinemia. Oral ertugliflozin has been used to treat hyperinsulinemia and Laminitis. The lack of a control group, the use of historical information, and the quick follow-up time all contributed to the study's limitations. In study (7), two horses with bilateral chronic Laminitis were exposed to long-term limited sand bedding accommodations and their effects on phalangeal rotation and hoof conformation. Laminitis horses' feet have been soothed with the alternative use of sand bedding confinement. Specifically following unfavorable outcomes from therapeutic shoeing, this article provided proactive housing management to alleviate chronic Laminitis in horses. Study (8) mentioned nutritional management essential to achieving and maintaining a good body condition while lowering the risk of Laminitis caused by food. A personalized dietary plan for horses with PPID can be created using the method suggested in the article. Adaptations must be made based on activity level and life stage. Article (9) covers three cases when serious foot pathology was treated surgically and by wearing a wooden shoe. The concepts used in the article were farriery. The study may be beneficial as an additional treatment option for various serious foot disorders, maybe providing an alternative to a humane death.

The study (10) examined the interactions between a farrier and a client when risk management was done for a horse recovering from Laminitis. The consultation was recorded on video, and its conversational components were analyzed to establish its linguistic and

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paralinguistic composition. The body of evidence was necessary for effective practitioner education in cooperation with clients to promote their commitment to treatment and care regimens. The research (11) aimed to address the intricate foot difficulties in both of the pony's front legs, which included a 22-year-old gelding pony with shorn heel and a diagnosis of bilaterally chronic Laminitis. It was decided to utilize adjusted Z-bar shoes. The left front hoof has an unsupported toe, and the right front hoof has an unsupported toe in a standard bar shoe. Strategic shoeing alterations are essential to control distally phalanx rotations in laminitis horses with shaved heels and complicated hoof problems. The article (12), provided EMS/insulin-dysregulated horses with a modest dose of the synergistic leucine-containing polyphenols and amino acid combination (SPB+L) would improve their metabolic health. Resistance to insulin and insulin dysregulation were used in the data analysis. Giving horses with EMS or insulin dysregulation an SPB + L diet supplement would be beneficial. The paper (13) examined the several facets of supportive care that veterinary nurses can offer to laminitis horses in hospitals, including monitoring, environmental control, cryotherapy, feeding, and sun support. The Obel Scale and Modified Obel Scales can be combined with this tool. Veterinarian nursing is essential to caring for a hospitalized horse with acute Laminitis and can significantly affect how well a patient does.

The study (14) improved the prolonged euglycaemic-hyperinsulinaemic clamp (p-EHC) approach, which has previously been utilized to induce Laminitis by administering an amount of insulin that is above physiological. The modified Obel approach was used to evaluate every aspect of the horse's lameness, and a veterinarian also performed a comprehensive health checkup on each one. In a study (15), the gaits kinematic effect of three types of clog shoes on the gaits of laminitis horses, as well as comparisons between the speeds of healthy and Laminitis horses. A few of the therapeutic techniques used included no-shoes applications. On the other hand, the wooden clog led to an apparent lengthening of the stride.

Materials and Methods

The Institutional Animal Welfare and Usage Committee at Colorado State University examined and authorized the study's methodology. Between April and August, adult horses older than two years old were sequentially enrolled prospectively with informed client agreement. Three categories there were registered cases, there are

- Horses that exhibit Laminitis clinically and radiographically (n = 15)
- The primary horse's gastrointestinal illness (n = 13)
- (n = 13) healthy horses

These are provided for other than medical uses, such as an advance purchases exam or routine dental care. For each patient, the signaling and initial clinical diagnosis was noted. Based on the presentation, the horses were divided into three groups. The left jugular vein was venipuncture to obtain blood samples. Separated plasma and serum were kept until analysis, heading in polypropylene vials in a seventy degrees Celsius refrigerator. In a chemiluminescent immunoassay, the amounts of serum cortisol, plasma ACTH, and thyroid

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hormone (thyroxine, T4) were all measured. Histamine levels in plasma were evaluated following immunoassay validation in horse plasma.

To check for a normal distribution, the Shapiro-Wilks test was run on all continuous variables, and those that did were presented as median and interquartile range. SAS 9.1 was used for the statistical analysis. The least squares mean test was used to further analyze significant differences through individual comparisons. The cutoff for statistical significance was $p<0.05$.

Results and discussion

The 40 horses in all were registered, including 15 American Quarter Horses, 6 American Paint Horses, 6 Arabians, 6 Warmbloods, 2 Thoroughbreds, 1 Tennessee Walking Horse, 1 Morgan, 1 Shire, 1 Appaloosa, and 1 English Riding Pony. The horses' ages ranged from three to twenty-six, with eleven being the average. The gender split between each group was as follows: There were five mares, one stallion, and eight geldings in Laminitis Group 1. There were five mares and five geldings in GI group 2. Group 3 had five geldings and seven mares. Chronic Laminitis affected nine of the laminitis group of horses, while five only had acute instances. Three cases of acute Laminitis occurred while patients were being treated for orthopedic problems in a hospital, and the other two were admitted within two days of the onset of symptoms after ingesting spring grass. The GI group contained three cases of colitis with no known cause and nine surgical colic patients. Eight horses were brought for a regular lameness workup, and four mares with sick companion foals made up the control group. The average duration of hospitalization for the laminitis group was three days, the GI disease group was four days, and the control group was seven days. The groups included a healthy group, a group with gastrointestinal illness, and a group with Laminitis. For comparison, the reference ranges for every marker are also given. In the healthy group (Table 1), the average T4 level in the group of people in good health was within the acceptable range. The healthy group's intermediate eACTH level was lower than the recommended range. The average cortisol level in the group of healthy people was within the reference range. The average histamine level was within the normal range in the group of health. Table 1 depicts the Value of the Healthy group.

Table (1): Values of healthy group

Test	Reference Range	Healthy Group
eACTH (pg/mL)	18-25	14.15(9.65-19.85)
Histamine (pg/mL)	4.6-11.16	6.78(5.37-7.59)
Cortisol (mg/dL)	3.6-4.5	4.45 (2.55-5.82)
T4 (mg/dL)	1.0-2.5	1.87(1.43-2.42)

In the Gastrointestinal Disease Group, the average T4 level (across the group) was below the reference range. The intermediate ACTH level was substantially higher than the

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recommended range. The average cortisol level was significantly higher than the reference range. The average histamine level was which fell within the reference range. Table 2 depicts the outcome of the gastrointestinal disease group.

Table (2): Outcome of gastrointestinal disease group

Test	Reference Range	Gastrointestinal disease group
eACTH (pg/mL)	18-25	32.72(16.52-46.62)
Histamine (pg/mL)	4.6-11.16	7.18(5.16-8.84)
Cortisol (mg/dL)	3.6-4.5	8.22(6.62-12.52)
T4 (mg/dL)	1.0-2.5	0.92 (0.90-0.92)

In the laminitis group, the average T4 level was which is within the normal range. The intermediate ACTH level was ranged within the reference range. The intermediate cortisol level was which was within the reference range. The intermediate histamine level was which fell within the reference range. Table 3 depicts the values of the Laminitis Group.

Table (3): Values of laminitis group

Test	Reference Range	Laminitis group
eACTH (pg/mL)	18-25	22.72(16.27-37.72)
Histamine (pg/mL)	4.6-11.16	7.97 (7.23-9.49)
Cortisol (mg/dL)	3.6-4.5	4.47(3.62-8.42)
T4 (mg/dL)	1.0-2.5	1.90 (1.02-2.25)

The statistical importance of the observed variations between the groups is shown by the p-values in Table 4. A p-value of less than 0.05 is typically regarded as statistically significant, indicating that the differences seen are unlikely to result from pure chance. For instance, the p-value for Thyroxine (T4) is stated as 0.001, suggesting a significant difference in Thyroxine (T4) levels between the healthy and Laminitis groups. Also showing statistically significant changes between the groups are the p-values for ACTH, Cortisol, and Histamine. Table 4 depicts the result of the p-value.

Table (4) Result of a p-value

Test	P value
Thyroxine (T4) (mg/dL)	<0.001
eACTH (pg/mL)	0.033
Cortisol (mg/dL)	0.004
Histamine (pg/mL)	0.045

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The stress hormone levels were different In contrast to horses in good health, with GI disorders and Laminitis. Comparing animals with GI illness, controls and laminitic horses had significantly lower serum T4 levels. Figure 1 depicts the serum T4.

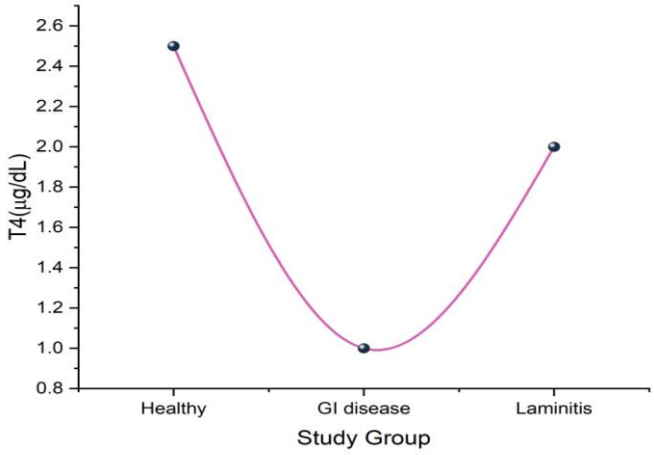

Figure (1): Result of Serum T4

The immune system's response to stress and inflammation can be used to explain the elevated plasma levels of eACTH (equine adrenocorticotropic hormone) found in Laminitis and gastrointestinal (GI) disease-affected horses as compared to controls. Figure 2 displays the result of plasma eACTH.

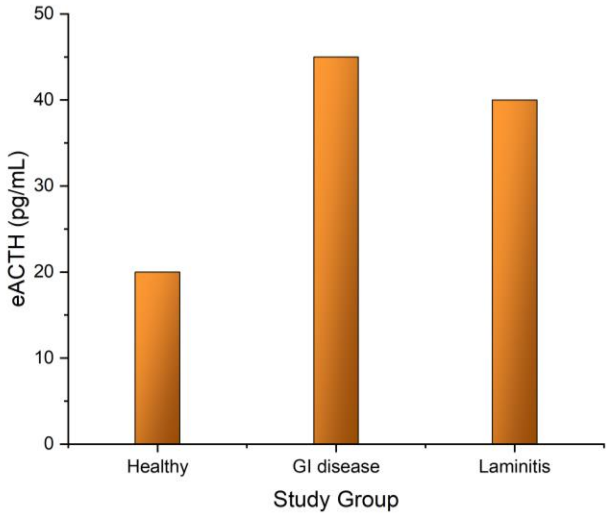

Figure (2): Result of plasma eACTH

The immune system's response to acute stress and inflammation associated with GI illnesses can explain the considerable increase in blood cortisol levels in horses with gastrointestinal disease compared to Laminitic or controlled horses. Figure 3 represents the serum cortisol.

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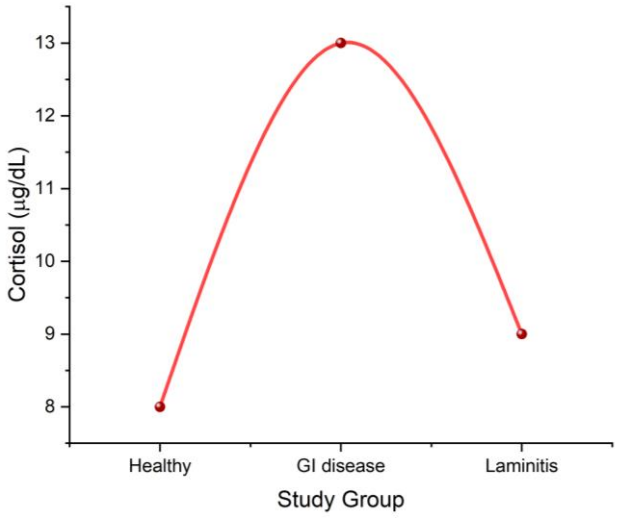

Figure (3): Result of serum cortisol

The underlying processes and inflammation linked to Laminitis can explain why plasma histamine levels are much greater in laminitic horses compared to horses with gastrointestinal disorders and ordinary horses. Figure 4 shows the plasma histamine.

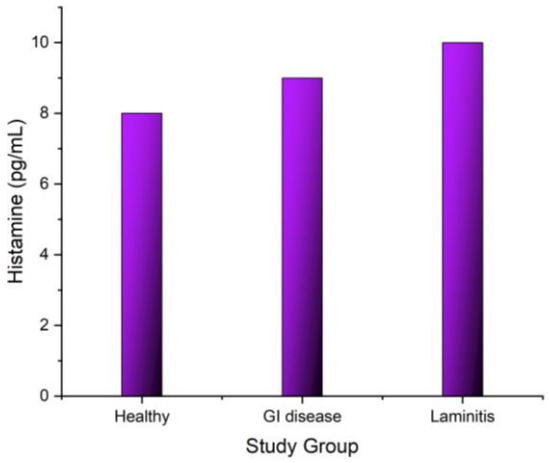

Figure (4): Result of plasma histamine

Conclusion

According to the study's findings, laminitis horses had altered levels of stress response hormone (cortisol, T4, histamine, eACTH) compared to those with gastrointestinal disorders or healthy controls. Histamine plasma concentrations were higher in laminitic horses than in the other groups. Horses with GI problems showed lower serum T4 concentrations and greater plasma cortisol levels than laminitis horses or healthy controls. Laminitis and GI-ill horses reported greater plasma ACTH concentrations than healthy controls. The findings hold promise for monitoring or diagnosing Laminitis as a problem in hospitalized patients using stress hormone levels. This high-level, early study examines the abundance of stress chemicals at a certain moment. Additional research must be done on each hormone's profile,

especially histamine. Future studies should also study the effects on primary illness severity and chronicity.

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