Prevention of Recurrences of Equine Airway Obstruction with Acupuncture: A Case Study

Rebecca Douglass

Table of Contents

Abstract

Horses cannot thrive, perform, or win if they struggle to breathe. Equine recurrent airway obstruction (RAO), a chronic respiratory condition, significantly affects a horse's performance and imposes a considerable financial burden for long-term management. Acupuncture demonstrates remarkable effectiveness by reducing symptoms, lowering medication requirements, and enhancing the horse's quality of life. Acupuncture accomplishes this by decreasing inflammation, improving lung function, regulating the immune system, and reducing allergen sensitivity. Increasingly recognized by its potential, acupuncture works by preventing system recurrence while promoting overall wellness. The case study illustrates how preventative acupuncture significantly ameliorates recurrent airway obstruction by substantially alleviating symptoms, reducing medication, and decreasing the recurrence of RAO. Over eight months, a 12-year-old Shetland pony received fourteen acupuncture treatments, resulting in the cessation of both coughing and medication needs while facilitating easier breathing during exertion. Therefore, acupuncture shows to be a cost-effective method for managing clinical cases of allergy induced RAO when initiated before symptoms start.

Keywords: equine recurrent airway obstruction, acupuncture, equine chronic respiratory conditions, equine COPD, heaves

Introduction

Recurrent Airway Obstruction

Equine recurrent airway obstruction (RAO), a chronic respiratory disease exhibits symptoms of expiratory dyspnea, airway hyperreactivity, exercise intolerance, airway smooth muscle contraction, and severe inflammation. This subset of equine asthma affects the lower airway passages. Medication treatments include corticosteroids and bronchodilators for acute episodes of RAO (Robinson, 2003, pp. 417-421). RAO occurs in 14% of the horse population with characteristic local and systemic inflammatory markers along with chronic remodeling of the bronchial walls and pulmonary connective tissue (Barton & Gehlen, 2016). Similar to human asthma, RAO is diagnosed through clinical signs, imaging, endoscopy, lung function tests, cytology, and clinical staging of the disease (Kozłowska et al., 2022; Simoes & Tilley, 2023). With chronic RAO, horses display external abdominal oblique hypertrophy (a heaving line) (Niedźwiedź, 2014) from prolonged difficulty exhaling, reduced lung capacity, and increased pulmonary resistance (Moran & Folch, 2011). Chronic RAO evolves into an incurable and debilitating disease characterized by repeated "bronchoconstriction and neutrophilic airway inflammation" (Moran & Folch, 2011, p. 1). The chronic form of this disease significantly affects a horse's performance (Leduc, 2024), diminishes performance capabilities (Tangjitjaroen et al., 2009), and negatively impacts overall horse welfare (Mainguy-Seers et al., 2024). Consequently, horse owners face not only the loss of a performance horse but also the financial burden of long-term medication, nebulizers, and ongoing care.

RAO Conventional Treatment

Traditional treatment for RAO necessitates owner education for compliance regarding medication and horse care protocols (Diez de Castro & Fernandez-Molina, 2024). However,

since these treatments do not address the underlying cause of allergic hypersensitivity, managing RAO proves both challenging and costly. This allergic component derives from environmental irritants, seasonal allergens, dust, and mold (Leduc, 2024; Robinson, 2003, p. 793). Dust, allergens, and fungal spores activate cytokine production and neutrophil mobilization (Niedźwiedź, 2014). Mańkowska & Witkowska (2024) found that environmental toxins were the number one cause of equine asthma. Environmental pollutants such as airborne organic /inorganic particulates, bacteria, fungi, viruses, and airborne irritants mandate environmental management and housing changes to prevent future attacks or lessen symptoms' severity. Management includes pasture living, proper stabling ventilation, ground feeding, superior hay quality, hay steamers, hay soaking, and dust-free bedding (Orard et al., 2018; Tacoma Equine, 2017). However, mitigating all environmental antigens is problematic, resulting in recurrence and chronic disease progression even when using medication to control RAO (Simoes & Tilley, 2023). Therefore, treatment needs to address allergen sensitivity in horses with RAO.

Complementary and Alternative Treatments (CAM)

Several interesting articles point to success in CAM treatments for RAO including herbs, nutraceuticals, and acupuncture. For instance, research indicates a connection between allergic hypersensitivity, intestinal microbiota, and RAO (Kaiser-Thom et al., 2020). Imbalance in microbiota can lead to increased allergic reactions in humans, contributing to asthma. (Kaiser-Thom et al., 2020). In horses, the environment directly affects the microbiome leading to immune hypersensitivity in RAO (Kaiser-Thom et al., 2020) and the connection between the gut and lung. (Leduc et al. (2024). Additionally, nutritional treatments have shown positive effects by focusing on the supplementation of selenium, Vitamin E, and ascorbic acid, benefitting the

pulmonary epithelial lining (Stucchi et al., 2022) (Youseff et al., 2013). Furthermore, CAM therapies such as herbal medicine (Stucchi et al., 2022) and acupuncture (Tangjitjaroen et al., 2009) have shown promise in treating equine RAO.

Our study concentrates on using acupuncture in the prevention and treatment of RAO. In our case study, we looked at the use of preventative acupuncture administered months prior to typical recurrent RAO symptoms that occur during peak allergy season. To understand the role of acupuncture, let's look at the literature on of acupuncture in the treatment of RAO.

Background

Acupuncture for RAO

Due to the holistic nature of Chinese medicine (CM), veterinarians and owners have looked to acupuncture and Chinese herbal medicine to manage and treat RAO especially when medication becomes too expensive or less effective. While one single treatment via acupuncture has proven unhelpful in RAO (Wilson et al., 2004), acupuncture and herbal medicine are showing promising results in RAO by treating symptoms, reducing medication requirements and improving the horse's quality of life (Tangjitjaroen et al., 2009). In addition, Chinese medicine recognizes the disease complexity by addressing lung function, immune dysfunction, allergen hyperactivity, and digestive health (Xie et al., 2012). CM research show promise for RAO treatment by alleviating inflamed pulmonary tissue through cellular and humoral immunity (Tangjitjaroen et al., 2009). Li et al. (2021) explore acupunctures' key principle of "preventing immune overreaction" as an essential component in immune regulation and treatment of RAO. In addition, acupuncture is well-documented in improving pulmonary function and treating asthma (Lai et al., 2023; Scheewe et al., 2011; Wang et al., 2023; Zu et al., 2012). Acupuncture is also a cost-effective treatment for allergies, a known contributor to RAO

(Pfab et al., 2014). Finally, current research in humans is linking the gut microbiome to allergic responses (Di Vincenzo et al., 202; Petrillo et al., 2025). Therefore, acupunctures effectiveness in changing gut microbiota and improving gastrointestinal symptoms in multiple diseases can be an important component to treating RAO (Jiang et al., 2023; Liu et al., 2024; Takahashi, 2006; Wang et al., 2024; Xu et al., 2020; Xu et al., 2023). Finally, Tangjitjaroen et al. (2009) discusses acupuncture's effectiveness in stimulating airway mucus removal, reducing inflammation, activating the parasympathetic nervous system, and modulating the immune system. This research presents acupuncture as a viable treatment option for RAO in horses.

Mechanisms of Acupuncture

Chronic diseases often involve a significant amount of long-term inflammation in the body. One way to assess the effectiveness of acupuncture in treating RAO is by examining its impact on inflammation. A study conducted by Xu et al. (2012) demonstrated that acupuncture has an immune-modulating effect and also regulates proteins that are associated with inflammatory processes. For instance, rat lung inflammatory proteins were reduced when BL-12, BL-13, and GV-14 were manually stimulated once every other day for two weeks. Pulmonary function, bronchoalveolar fluid and lung tissue was assessed. "The expression levels of 32 protein spots were altered after acupuncture treatment in the rats with asthma onset but not changed after acupuncture treatment in the normal rats, which essentially indicated the pathology-specific regulation of acupuncture" (Xu et al., 2012, p.5). Therefore, acupuncture was able to down regulate the inflammatory proteins in rats with asthma in addition to reducing leukocytes and eosinophils in a fluid sample from the lungs (Xue et al., 2012).

Addedly, acupuncture creates strong anti-inflammatory effects on multiple organ systems including the immune and respiratory systems (Li et al., 2021). Acupuncture also effects

various systems of the body. Acupuncture influences connective tissue, regulates immune system molecular secretions, and transmits signals through the nerves, spinal cord, neurotransmitters, and hormones. In addition, acupuncture improves human lung functions in patients with COPD and asthma through immune pathways of monocytes, macrophages and lymphocytes (Li et al., 2021). In agreement with these findings, Scheewe et al. (2011) found acupuncture had a significant therapeutic effect in childhood asthma by improving bronchial hyperreactivity and reducing inflammatory cytokines.

Acupuncture effects lung function too. Wang & Jin (2024) showed that acupuncture could alleviate airway remodeling and reduce airway resistance by regulating various signal pathways. Wang et al. (2023) stated "acupuncture can treat bronchial asthma by controlling the inflammatory response, preventing airway remodeling, improving lung ventilation, improving cellular immune function, and regulating the neuroendocrine network" (p.13). Wang & Jin (2024) also demonstrated acupunctures effected asthma by regulating inflammatory cells, balancing the inflammatory response, remodeling airways, down regulating the expression of proteins, relieving lung resistance, relaxing airway smooth muscle, inhibiting histamine release, improving anti-asthma drugs effects, and altering epigenetics.

Acupuncture Protocols

Tangjitjaroen et al. (2009) propose that acupuncture can provide a safe and effective therapy for equine RAO by replacing bronchodilators and anti-inflammatory medications. Electro acupuncture or dry needling can be used for 15-45 minutes to stimulate the following points: BL-13, BL-23, CV-17, CV-22, LU-9, LI-4, LI-11, ST-36, GV-14, Ding Chuan, Fei Pan, Fei Men. This protocol is used to alleviate asthma like symptoms.

Another study done by Li et al. (2021) discussed acupoints that mediate the immune system for anti-inflammatory effect. These include GV-14, BL-12, Ding Chaun, and PC-6 with and the most common points of BL-13, ST-36 and LI-4. Since acupoints contain a three-dimensional array of nerves, blood vessels, and connective tissue, there is a network of communication via cytokines and chemokines that transmit information once a point is punctured (Li et al., 2021). Other studies have shown similar effects. Lai et al. (2023) showed that treatment of BL-13 and ST-35 improved pulmonary function and lung inflammation in asthmatic rat. According to Wang et al. (2024) additional effective acupoints for asthma treatment are BL-12, BL-13, BL-15, LU-5, BL-14, GV-14, CV-17, LU-1, ST-36, SP-6, and Dingchuan.

Schoen et al. (1994) outlines the Chinese medicine diagnosis and treatment for RAO in equines (previously called equine chronic obstructive pulmonary disease). Chinese patterns of differentiation were for either invasion of wind cold or phlegm heat. Recommended points were BL-13, BL-14, BL-15, LU-1, LU-7, LU-8, LU-9, PC-6, KI-10, KI-27, ST-36, ST-45, GV-14, GV-20, LI-4, LI-20, TH-1. Dry needling was recommended for 15-20 minutes every three to seven days for a total of 4-8 treatments. Point prescriptions were very similar with Flaws & Sionneau (2007). Their treatment of human asthma used similar points to Schoen with the additions of CV-22, ST-44, LI4, ST-36, ST-40, LU-1, PC-6, and KI-3 depending on the diagnosis.

Differentiation of RAO

The most effective treatments for RAO are based on the individual horse's underlying imbalances or patterns. This differentiation (based on signs and symptoms) is the holistic approach that guides treatment options and acupuncture point selection for a tailored and

effective intervention. Xie & Preast (2007) differentiated equine RAO into four patterns with subsequent symptoms and treatment as seen below in Table 1. These patterns are similar to Flaws & Sionneau (2007) differentiation for asthma in human.

DIAGNOSIS	SYMPTOMS	TREATMENT
Invasion of Wind Cold	cough, asthma, worse with exposure to cold, less coughing in warm, nasal obstruction, easily cold, purple tongue and superficial pulse	LU7, LI1, GB20, BL10, BL12, BL13, ST40, Ding Chuan, CV12
Phlegm Heat Accumulation	loud cough, rapid breath, yellow thick nasal discharge, sore/swollen throat, dry feces, scant urine, thirst, red gums, rapid pulse	LU5, LU6, LU7, ST40, LI11, PC5, CV22, Ding Chuan, BL13
Deficiency of Lung Qi	recurring respiratory illness, heave line, chronic clear nasal discharge, spontaneous sweating, weak/chronic asthma that worsens with movement, lassitude, weak pulse, pale tongue	BL13, CV17, CV6, LU9, CV22, LU7, DIng Chuan, Bai Hui
Deficiency of Lung Qi & Kidney Qi	lethargy, fatigue, rapid/weak breath worse with movement, shortness of breath, difficult inhalation and exhalation, cold limbs and trunk, prolonged cough or asthma, pale/swollen tongue, feeble pulse	BL13, BL23, CV17, CV4, CV6, LU9, LU7, Shen Shu

Table 1

These differentiated patterns supply the practitioner with educated starting points for addressing equine RAO with acupuncture. These points are used to reduce inflammation, modulate immunity, decrease airway resistance, and lower medication use. These differentiation patterns were referenced in the following case.

Case Study

Case Presentation

A 12-year-old Shetland pony gelding displayed the symptoms of cough, exercise intolerance, labored respiration worse on exhale, and a marked heave line. The symptoms recurred every spring and summer. He was diagnosed with allergy induced RAO by the attending veterinarian and was given dexamethasone for the first episode and then clenbuterol for maintenance. The owner was interested in a more holistic approach but had tried herbal remedies with no relief of symptoms. The owner decided to try acupuncture as a potential treatment to lower the pony's dependence on prescription medication.

Treatment concentrated on the prevention of RAO by administering 14 treatments, once weekly starting in February then once monthly treatments from May through September. At the start of treatment, the pony presented only very mild symptoms. The pony's symptoms typically worsened from May to September, prompting preventative treatment to begin before exacerbation. Treatment was based on the diagnosis deficiency of Lung and Kidney qi with phlegm obstructing the lungs. Points used were bilateral KI-3, UB-23, UB-13, LU-1 or LU-7, Ding Chuan, ST-40 and CV-17. The following year, the treatments were repeated in winter. Six treatments were given one week apart then 4 treatments one month apart from March to August. Two years later, the pony only received 6 treatments once monthly from March to August. No treatments were needed again for 3 years when he had a recurrence of cough and difficulty breathing. At that point, 3 weekly treatments were administered in June.

Results

The first year, the pony never experienced an acute episode of RAO even during peak allergy season when the management of symptoms was usually very difficult. The pony did not

need medication that year and was managed with only the usual environmental changes (fresh air, wetted hay and low dust bedding). The following two years showed the same positive results. At this point, acupuncture treatments were discontinued, and the pony was managed with stable and environmental changes only until a recurrence three years later. Five years after the initial treatments, the pony was then sold to a new owner.

Discussion

The results of this case study support the literature that acupuncture can be an effective means of treating and managing equine RAO. In this case study, the pony not only had amelioration of symptoms but also discontinued medication saving the owner time and money. The emphasis in this study was placed on starting treatment before the symptoms recurred in the spring and summer of each year. This meant treatments began in winter before the allergic components contributing to the RAO were present in the environment. This was to prevent the onset of RAO symptoms. In this case, the treatment strategy was effective. Ideally, more equines diagnosed with an allergic cause of RAO are needed to determine the efficacy and application of this technique on a larger population.

Conclusion

Equine recurrent airway obstruction (RAO) is a chronic respiratory disease occurring in 14% of the equine population with symptoms that causes inflammation, difficulty breathing, immune dysfunction, and exercise intolerance. Management includes good ventilation, low dust hay and bedding, clean environment free of allergens, medications, nebulizers, and ongoing care leaving horse owners searching for alternative methods. Acupuncture has proven to reduce inflammation, improve lung functions, alleviate airway remodeling, reduce airway resistance, relax airway smooth muscle, inhibit histamine release, and improve the effects of anti-asthma

drugs. Animal acupuncture protocols are well documented in the literature that can be individualized through differentiation of symptoms. Once such equine case showed great promise in the clinical efficacy of using acupuncture in the treatment and management of equine RAO. This case reported a drastic decrease in both symptoms and medication use when preventative acupuncture was administered before the yearly allergen induced RAO recurred. The pre-symptom treatments utilized the principles of acupuncture in preventing illness and maintaining wellness. In this case, acupunctures use in the treatment of RAO was effective for many years prolonging the pony's usefulness and longevity.

References

Barton, A. K., & Gehlen, H. (2016). Pulmonary Remodeling in Equine Asthma: What Do We Know about Mediators of Inflammation in the Horse? Mediators of Inflammation, 2016https://doi.org/10.1155/2016/5693205

Budgell B. (2008). Guidelines to the writing of case studies. The Journal of the Canadian Chiropractic Association, 52(4), 199–204.

Diez de Castro, E., & Fernandez-Molina, J. (2024). Environmental Management of Equine Asthma. Animals, 14(3), 446. https://doi.org/10.3390/ani14030446

Di Vincenzo, F., Del Gaudio, A., Petito, V., Lopetuso, L. R., & Scaldaferri, F. (2024). Gut microbiota, intestinal permeability, and systemic inflammation: a narrative review. *Internal and Emergency Medicine, 19*(2), 275-293. https://doi.org/10.1007/s11739-023-03374-w

Flaws, B., & Sionneau, P. (2007). *The treatment of modern western medical diseases with Chinese Medicine : a textbook & clinical manual*. Blue Poppy Press.

Kaiser-Thom, S., Hilty, M., & Gerber, V. (2020). Effects of hypersensitivity disorders and environmental factors on the equine intestinal microbiota. The Veterinary Quarterly, 40(1), 97-107. https://doi.org/10.1080/01652176.2020.1745317

Klier, J., Bartl, C., Geuder, S., Geh, K. J., Reese, S., Goehring, L. S., Winter, G., & Gehlen, H. (2019). Immunomodulatory asthma therapy in the equine animal model: A dose-response study and evaluation of a long-term effect. Immunity, Inflammation and Disease, 7(3), 130-149. https://www.proquest.com/scholarly-journals/immunomodulatory-asthma-therapy-equine-animal/docview/2269843624/se-2

Kozłowska, N., Wierzbicka, M., Jasiński, T., & Domino, M. (2022). Advances in the Diagnosis

of Equine Respiratory Diseases: A Review of Novel Imaging and Functional Techniques. Animals, 12(3), 381. https://doi.org/10.3390/ani12030381

Lai, Y., Zhou, J., Ding, P., Liu, M., Pan, J., Li, N., Zhang, G., & Qiu, R. (2023). Effects of acupuncture at Feishu (BL13) and Tianshu (ST25) on pulmonary function and tissue inflammation in asthma model rats. Journal of Acupuncture and Tuina Science, 21(5), 346-355. https://doi.org/10.1007/s11726-023-1393-1

Leduc, L., Costa, M., & Leclère, M. (2024). The Microbiota and Equine Asthma: An Integrative View of the Gut–Lung Axis. Animals, 14(2), 253. https://doi.org/10.3390/ani14020253

Li, N., Guo, Y., Gong, Y., Zhang, Y., Fan, W., Yao, K., Chen, Z., Dou, B., Lin, X., Chen, B., Chen, Z., Xu, Z., & Lyu, Z. (2021). The Anti-Inflammatory Actions and Mechanisms of Acupuncture from Acupoint to Target Organs via Neuro-Immune Regulation. Journal of Inflammation Research, 14, 7191-7224. https://doi.org/10.2147/JIR.S341581

Liu, J., Pang, Z., Wang, G., Guan, X., Fang, K., Wang, Z., & Wang, F. (2017). Advanced Role of Neutrophils in Common Respiratory Diseases. Journal of Immunology Research, 2017https://doi.org/10.1155/2017/6710278

Liu, T., Wang, F., Wang, G., & Mao, H. (2017). Role of Neutrophil Extracellular Traps in Asthma and Chronic Obstructive Pulmonary Disease. Chinese Medical Journal, 130(6)https://doi.org/10.4103/0366-6999.201608

Lu, L., Zhang, Y., Tang, X., Ge, S., Wen, H., Zeng, J., Wang, L., Zeng, Z., Rada, G., Ávila, C., Vergara, C., Tang, Y., Zhang, P., Chen, R., Dong, Y., Wei, X., Luo, W., Wang, L., Guyatt, G., Tang, C., … Xu, N. (2022). Evidence on acupuncture therapies is underused in

clinical practice and health policy. BMJ (Clinical research ed.), 376, e067475. https://doi.org/10.1136/bmj-2021-067475

Mainguy-Seers, S., Holcombe, S. J., & Lavoie, J. (2024). Serum Vitamin D Level Is Unchanged in Equine Asthma. Animals, 14(22), 3310. https://doi.org/10.3390/ani14223310

Mańkowska, A., & Witkowska, D. (2024). The most common environmental risk factors for equine Asthma—A narrative review. Animals, 14(14), 2062. doi:https://doi.org/10.3390/ani14142062

Montgomery, J. B. (2019). Beyond steroids and bronchodilators – investigating additional therapies for horses with severe equine asthma. The Veterinary Record, 185(5), 140. https://doi.org/10.1136/vr.l4935

Moran, G., & Folch, H. (2011). Recurrent airway obstruction in horses – an allergic inflammation: a review. Veterinární Medicína, 56(1), 1-13. https://doi.org/10.17221/1566-VETMED

Niedźwiedź, A. (2014). Equine Recurrent Airway Obstruction. Macedonian Veterinary Review, 37(2), 115-120. https://doi.org/10.14432/j.macvetrev.2014.08.019

Niedzwiedz, A., Jaworski, Z., & Kubiak, K. (2014). Circulating immune complexes and markers of systemic inflammation in RAO-affected horses. Polish Journal of Veterinary Sciences, 17(4), 697-702. https://www.proquest.com/scholarly-journals/circulating-immune-complexes-markers-systemic/docview/1654725565/se-2

Orard, M., Hue, E., Couroucé, A., Bizon-Mercier, C., Marie-Pierre Toquet, Moore-Colyer, M.,

Couëtil, L., Pronost, S., Paillot, R., Demoor, M., & Richard, E. A. (2018). The influence of hay steaming on clinical signs and airway immune response in severe asthmatic horses. BMC Veterinary Research, 14https://doi.org/10.1186/s12917-018-1636-4

Petrillo, F., Buonanno, A., Fedi, L., Galdiero, M., Reibaldi, M., Tamburini, B., & Galdiero, E. (2025). Atopic Dermatitis and Atopic Keratoconjunctivitis: New Insights in the Analyses of Microbiota and Probiotic Effect. *International Journal of Molecular Sciences, 26*(4), 1463. https://doi.org/10.3390/ijms26041463

Pfab, F., Schalock, P. C., Napadow, V., Athanasiadis, G. I., Huss-Marp, J., & Ring, J. (2014). Acupuncture for allergic disease therapy - the current state of evidence. Expert Review of Clinical Immunology, 10(7), 831-41. https://doi.org/10.1586/1744666X.2014.924855

Robinson, N. E. (2003). Current therapy in equine medicine 5. W.B. Saunders.

Scheewe, S., Vogt, L., Minakawa, S., Eichmann, D., Welle, S., Stachow, R., & Banzer, W. (2011). Acupuncture in children and adolescents with bronchial asthma: A randomised controlled study. Complementary Therapies in Medicine, 19(5), 239-46. https://doi.org/10.1016/j.ctim.2011.07.002

Schoen, A. M., Blackmer, R., Fleming, P., & Michele Mccrea Wallentin. (1994). *Veterinary acupuncture : ancient art to modern medicine /*. Mosby, C.

Simões, J., Batista, M., & Tilley, P. (2022). The immune mechanisms of severe equine Asthma—Current understanding and what is missing. Animals, 12(6), 744. doi:https://doi.org/10.3390/ani12060744

Simões, J., & Tilley, P. (2023). Decision Making in Severe Equine Asthma—Diagnosis and Monitoring. Animals, 13(24), 3872. https://doi.org/10.3390/ani13243872

Stucchi, L., Lo Feudo, C. M., Stancari, G., Conturba, B., & Ferrucci, F. (2022). Effect of the

Administration of a Nutraceutical Supplement in Racehorses with Lower Airway Inflammation. *Animals, 12*(18), 2479. https://doi.org/10.3390/ani12182479

Tacoma Equine. (2017, September 11). Equine Asthma Syndrome (IAD/RAO). Tacomaequine. https://www.tacomaequine.com/post/2017/09/11/equine-asthma-syndrome-iadrao

Trope, G. (2013). Dynamic endoscopy of the equine upper airway - what is significant? The Veterinary Record, 172(19), 459. https://doi.org/10.1136/vr.f2934

Tangjitjaroen, W., Xie, H. S., & Colahan, P. T. (2009). Possible Mechanisms of Acupuncture for the Treatment of Chronic Inflammatory Disorders of the Equine Lower Airway. American Journal of Traditional Chinese Veterinary Medicine. https://doi.org/10.59565/001c.83749

Uberti, B., & Morán, G. (2018). Role of neutrophils in equine asthma. Animal Health Research Reviews, 19(1), 65-73. https://doi.org/10.1017/S146625231800004X

Wang, L., Luo, X., Qing, X., Fang, S., Jiang, T., Wang, Q., Zhong, Z., Yang, Y., Yang, J., Song, G., Su, X., & Wei, W. (2024). Symptom effects and central mechanism of acupuncture in patients with functional gastrointestinal disorders: a systematic review based on fMRI studies. BMC Gastroenterology, 24, 1-17. https://doi.org/10.1186/s12876-024-03124-y

Wang, F. X., & Jin, L. W. (2024). Research on the Mechanism and Application of Acupuncture Therapy for Asthma: A Review. *Journal of asthma and allergy*, *17*, 495–516. https://doi.org/10.2147/JAA.S462262

Wang, X., Zeng, S., Li, Z., Li, Y., & Jia, H. (2023). A network meta-analysis of different acupuncture modalities in the treatment of bronchial asthma. BMC Pulmonary Medicine, 23, 1-17. https://doi.org/10.1186/s12890-023-02645-8

Wilson, D. V., Berney, C. E., Peroni, D. L., Mullineaux, D. R., & Robinson, N. E. (2004). The effects of a single acupuncture treatment in horses with severe recurrent airway obstruction. Equine veterinary journal, 36(6), 489–494. https://doi.org/10.2746/0425164044877323

Youssef, M. A., El-khodery, S., Ibrahim, H. M., & Mohamed. (2013). Effect of Selenium and Vitamin C on Clinical Outcomes, Trace Element Status, and Antioxidant Enzyme Activity in Horses with Acute and Chronic Lower Airway Disease. A Randomized Clinical Trial. Biological Trace Element Research, 152(3), 333-42. https://doi.org/10.1007/s12011-013-9636-5

Yu-Dong, X., Jian-Mei Cui, Wang, Y., Lei-Miao, Y., Chang-Ke, G., Xiao-Yan, L., Wei, Y., Yan-Yan, L., Yong-Liang, J., Chun-Xiao, S., & Yong-Qing, Y. (2012). Proteomic Analysis Reveals the Deregulation of Inflammation-Related Proteins in Acupuncture-Treated Rats with Asthma Onset. Evidence - Based Complementary and Alternative Medicine, 2012, 14. https://doi.org/10.1155/2012/850512

Xie, H., Frank, L. R., Preast, V., & Trevisanello, L. (2012). Chinese veterinary herbal handbook. Jim Tang Publishing.

Xie, H., & Preast, V. (2007). *Traditional Chinese veterinary medicine: fundamental principles*. Chi Institute.

Xu, Y. D., Cui, J. M., Wang, Y., Yin, L. M., Gao, C. K., Liu, X. Y., Wei, Y., Liu, Y. Y., Jiang, Y. L., Shan, C. X., & Yang, Y. Q. (2012). Proteomic analysis reveals the deregulation of inflammation-related proteins in acupuncture-treated rats with asthma onset. *Evidence-based complementary and alternative medicine : eCAM*, *2012*, 850512. https://doi.org/10.1155/2012/850512

Xu, X., Feng, X., He, M., Zhang, Z., Wang, J., Zhu, H., Li, T., Wang, F., Sun, M., & Wang, Z. (2020). The effect of acupuncture on tumor growth and gut microbiota in mice inoculated with osteosarcoma cells. Chinese Medicine, 15, 1-15. https://doi.org/10.1186/s13020-020-00315-z

Xu, H., Wen, Q., Hu, H., Yang, S., Lu, L., Hu, X., Li, H., Huang, X., & Li, N. (2024). Electroacupuncture at ST36 modulates the intestinal microecology and may help repair the intestinal barrier in the rat model of severe acute pancreatitis. Microbial Biotechnology, 17(2)https://doi.org/10.1111/1751-7915.14401