Research Article

Hematological and Oxidant/Antioxidant Status in Recurrent Equine Eczema Of Egyptian Horses

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Abstract | Equine eczema is a hypersensitive, allergic skin condition that recurrently manifests in horses, especially in the summer season due to insect bites. This study aims to evaluate the hematological alterations, oxidant/antioxidant changes, and protein and lipid profiles in horses suffering from equine eczema. Thirty (30) horses were included in this study (20 males, 10 females), classified into the healthy control group (n = 10) and the equine eczema group (n = 20). All horses were subjected to a complete physical examination. Blood samples were collected for hematological profile and estimation of serum concentration of total antioxidant capacity (TAC), malondialdehyde (MDA), C-reactive protein (CRP), serum zinc, copper concentrations, total protein, albumin, globulin values, triglycerides, and cholesterol concentrations. The most consistent hematological alteration was elevated eosinophils in eczema-affected horses. The oxidant-antioxidant status showed a significant increase in malondialdehyde with a significant decrease in total antioxidant capacity, serum zinc, and copper concentrations. No significant changes were detected in both protein and lipid profiles. In conclusion, equine eczema is a stressful allergic skin disease that alters hematological and oxidant/antioxidant status in the equine and disrupts the horse's quality of life. Further studies regarding the addition of antioxidant compounds to the therapeutic regimen are needed.

Keywords | Horse; Eczema; Hematology; total antioxidant capacity; Lipid profile; Trace minerals.

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INTRODUCTION

Horses, like people, are prone to allergies from multiple etiologies (Moriello, 2019). During humid/hot seasons, insects, especially Culicoides, are abundant, and animals are exposed to their bites (Halldorsdottir et al., 1989; Hallamaa, 2017). These bites can cause a hypersensitivity reaction known as insect-bite hypersensitivity (Kurotaki et al., 1994; van Grevenhof et al., 2007). Insect-bite hypersensitivity is one of the main causes of equine eczema, or summer itch, one of the most common allergic skin diseases in horses (Hallamaa, 2017).

Itching is the main manifestation of summer eczema, particularly in the tail and mane areas (Halldorsdottir and Larsen, 1991; Björnsdottir et al., 2006). Pruritus intensity varies, though, in its severe state, self-excoriation and secondary bacterial infection may ensue (Hallamaa, 2009). The disease's global distribution is associated with the presence of Culicoides (Oliveira-Filho et al., 2012). The diagnosis depends mainly on history, examination, and response to insect control measures (Williams and Barrif, 2011).

Oxidative stress has recently been implicated in numerous equine diseases (Abdelnaby et al., 2020) and allergic skin diseases in other animal models (Kubesy et al., 2017). When a disturbance to equilibrium between oxidant and antioxidant sides occurs, oxidative stress will ensue (El-sayed et al., 2020). In one study of eczema, there was an implication that there is a strong association between eczema pathogenesis and increased malondialdehyde (MDA) levels (Amin et al., 2015). This oxidative stress can induce itching (Liu and Ji, 2012). Reactive oxygen species (ROS) is believed to play a role in the pathogenesis of several allergic skin diseases (Okayama, 2005). Copper and zinc play an integral role in antioxidant mechanisms in the body (Irshad and Chaudhuri, 2002).

Equine summer eczema is correlated with financial loss to owners and impairing the horse's quality of life. Few studies discussed the oxidant-antioxidant status associated with this condition. This study evaluates the hematological and oxidative changes in equine summer eczema.

MATERIALS AND METHODS

Animals

Thirty Arabian horses in good physical and nutritional conditions, they are intended for breeding. Each horse is in a separate stall. They have a daily shower after exercise and morning sunbath. Both sexes (20 males, 10 females) with an age range of 7-13yrs were included in this study and classified into: the healthy control group (n = 10) and the equine eczema group (n = 20), the latter was diagnosed by recurrence of clinical signs, specific lesions and concurrent with summer and insect bites. Samples were collected from different private studs in the El-Haram area, Giza Government, Egypt, between October 2019 and September 2021.

Examination and sampling

All horses were subjected to a full physical and clinical examination. Clinical signs at the time of the examination were recorded.

Blood samples were collected from all horses and divided into two parts. The first sample was collected in EDTA tubes for hematological analysis with an automated hematology analyzer (IDEXX Lasercyte ®, USA).

The second part was collected in plain tubes for serum separation for estimation of total antioxidant capacity (TAC), malondialdehyde (MDA), zinc, copper, total protein, albumin, globulin, triglycerides, and cholesterol concentrations using specific test kits (Bio-diagnostic Egypt, Spectrum Diagnostic Egypt). Slide test for C- reactive protein kit was obtained from VITRO SCIENT, Egypt, and was estimated in serum samples by a semi-quantitative method based on the principle of agglutination according to the method described by Jensen and Kjelgaard-Hansen, (2006).

Statistical analysis

The obtained data were analyzed using the Independent-Samples T-test, the SPSS software package for Windows Ver. 20.0 (SPSS Inc., Chicago, IL, USA) and tabulated as mean value ± SE at levels of significance $p \leq 0.001$, $p \leq 0.01$, and $p \leq 0.05$. The p-value of $p \leq 0.001$ was considered highly statistically significant.

RESULTS AND DISCUSSION

Summer eczema is a disease of seasonal recurrence characterized by allergic dermatitis caused by culicoid bites (Oliveira-Filho et al., 2012). Clinical signs of horse summer eczema are depicted in Figures (1-4). The most common clinical signs are seen in the head, mane, tail, and dorsal mid-line. These lesions are characterized by intense pruritus which results in rubbing and alopecia, skin damage, thickening, and scale formation. These signs were described in previous studies (Björnsdottir et al., 2006).

Figure 1: Showed area of alopecia with scales and skin thickining on mane, head and around the eye.

Figure 2: Showed area of alopecia with scales and skin thickining on mane, head and around the eye.

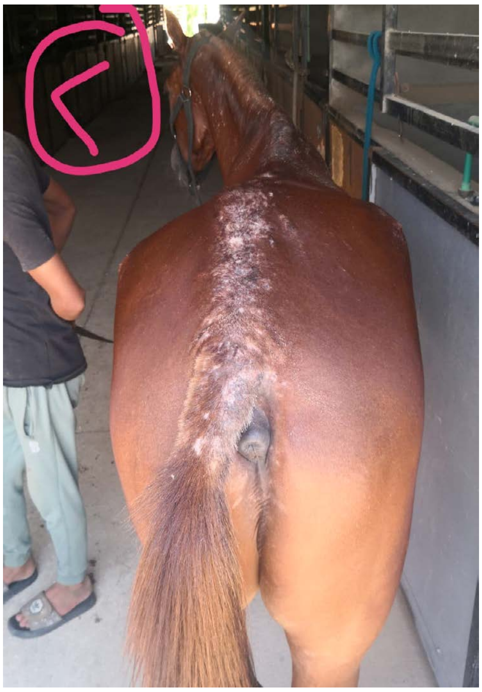

Figure 3: Showed alopecia, scales and skin thickening on mane, dorsal midline and tail.

Figure 4: Showed alopecia, scales and skin thickening on mane, dorsal midline and tail.

Table 1 shows the hematological alterations. Significant increase in eosinophils but no increase in neutrophilia recorded in patients when compared with control data. A hypersensitivity reaction triggered by culicoides bites causes pruritus and activates an immune response, leading to elevated eosinophils in circulation (Long et al., 2016). This finding was on par with Ono et al. (2021) who found an increase in eosinophil levels in the summer, which is associated with allergic skin dermatitis caused by Culicoides hypersensitivity. Similar findings were recorded in other skin affections and parasites. For instance, in sheep-infested lice, Tadie et al. (2018) recorded an increase in the numbers of eosinophils due to allergic reactions caused by irritation of lice infestation.

Insignificant elevation in neutrophils was recorded in this study, and elevation in neutrophils was recorded in atopic dogs (Walaa et al., 2008). This elevation might be attributed to the immediate-type hypersensitivity reaction leading to frequent scratching and resulting in secondary pyoderma, which induces neutrophilia (Jaheen, 2015). The erythrogram results were within normal limits. In flea allergic dermatitis and tick infestations, erythrogram activity was within the normal ranges (Wojciech et al., 2007; Burcak and Abdulkadir, 2011; Jaheen, 2015). However, in cases of lice infestation, RBC indices decreased but were within normal ranges (Tadie et al., 2018).

Oxidant-antioxidant patterns altered in eczema-affected patients, with a significant increase in MDA and a significant decrease in TAC, zinc, and copper when compared with control data (Table 2). To our knowledge, only scanty papers have discussed this topic regarding summer eczema in horses. However, in alopecia-areata patients, there was a reduction in TAC (Bakry et al., 2014; Baek and Lee, 2016). Also, in human patients, rosacea and seborrheic dermatitis showed a significant decrease in TAC (Tisma et al., 2009; Emre et al., 2012).

The body responds to an excess of MDA (an oxidant) production by activating an antioxidant scheme, resulting in a disruption in the delicate balance between oxidant and antioxidant (Abdelnaby et al., 2020).MDA elevation was recorded in other skin diseases such as seborrheic dermatitis (Ozturk et al., 2013), Pemphigus Vulgaris (Nazirog et al., 2003), and acne (Perihan et al., 2012). In a study on atopic dermatitis, it was found that patients are more susceptible to oxidative/ROS damage compared to healthy counterparts; they postulated that the addition of an antioxidant to the therapeutic regimen might be beneficial to these patients, although this benefit is yet to be figured out (Sivaranjani et al., 2013). Moreover, the addition of vitamin E (an antioxidant vitamin) was studied in atopic patients and showed promising results in improving the SCORAD (scoring for atopic dermatitis) index (Javanbakht et al., 2011). These findings might be of importance in understanding the pathogenesis of the disease, as was suggested in human patients with eczema (Amin et al., 2015). Further studies are needed to determine the beneficial impact of adding antioxidant supplementation to the therapeutic regimen.

Zinc is an important trace element. It plays an integral role in the antioxidant system as it is a chief component of Zn-Cu Superoxide dismutase (SOD), a frontrunner in the antioxidant system (Elsayed et al., 2020). In this study, a significant decrease in zinc was recorded in affected patients. Zinc levels were lower in allergic conditions, atopic dermatitis, and acne, and this could be attributed to the

Table 1: Hematological profile of equine eczema group compared to healthy control group.

Parameters	Control (n = 10) Mean± SE	Equine eczema (n=20) Mean± SE
Hemoglobin (gm %)	12.84 ± 0.15	12.28± 0.43
RBCs ($10^6/mm^3$)	8.22 ± 0.21	8.06 ± 0.19
PCV %	35.49 ± 0.55	34.81 ± 0.84
MCV (fl)	44.63 ± 0.87	42.82 ± 1.04
MCH (pg)	16.13 ± 0.31	15.02 ± 0.41
MCHC (g %)	36.13 ± 0.19	35.32 ± 0.73
WBCs ($10^3/mm^3$)	8.51 ± 0.46	8.99 ± 0.57
Neutrophils ($10^3/mm^3$)	3.38 ± 0.52	4.51 ± 0.51
Lymphocytes ($10^3/mm^3$)	3.87 ± 0.65	3.36 ± 0.25
Monocytes ($10^3/mm^3$)	0.74 ± 0.18	0.50 ± 0.06
Eosinophil ($10^3/mm^3$)	0.16 ± 0.08	0.63 ± 0.05[a]
Basophils ($10^3/mm^3$)	0.00 ± 0.00	0.00 ± 0.00

a: $p \leq 0.001$; b: $p \leq 0.01$; c: $p \leq 0.05$

Table 2: Biological profile of equine eczema group compared to healthy control group.

Parameters	Control (n = 10) Mean± SE	Equine eczema (n=20) Mean± SE
Antioxidant Status		
TAC (mM/L)	0.95 ± 0.07	0.69 ± 0.05[b]
MDA(nmol/mg)	1.49 ± 0.13	3.92 ± 0.35[a]
CRP (mg/L)	6.00 ± 0.00	6.00 ± 0.00
Zinc (µg/dL)	63.19 ± 3.63	50.20 ± 2.22 [b]
Copper (µg/dL)	90.50 ± 5.48	73.39 ± 2.65[b]
Protein Profile		
Total protein (g/dL)	6.55 ± 0.29	6.84 ± 0.20
Albumin (g/dL)	3.23 ± 0.89	3.15 ± 0.11
Globulin (g/dL)	3.32 ± 0.26	3.68 ± 0.15
Lipid Profile		
Triglycerides (mg/dL)	21.82 ± 0.74	20.66 ± 0.97
Cholesterol (mg/dL)	88.70 ± 3.73	85.50 ± 0.99

a: $p \leq 0.001$; b: $p \leq 0.01$; c: $p \leq 0.05$

exhaustive stress factors associated with allergic/inflammatory conditions (Ozdemir, 2014; Ozuguz et al., 2014; Amin et al., 2015). It was postulated that a deficiency of zinc could contribute to dermatitis (Maret and Sandstead, 2006). Copper also showed a significant reduction in eczema that affected horses. The lower copper level was seen in alopecia areata (El-Ashmawy and Khedr, 2013). Copper plays a key role in dermal papilla cells' proliferation and differentiation; these cells are dedicated fibroblasts that play an imperative role in the growth of hair follicles (Pyo et al., 2007). Reduction in minerals like zinc and copper may contribute to the occurrence of oxidative stress (Mohamad, 2013).

An insignificant decrease in albumin and cholesterol concentrations along with levels of insignificant changes in CRP levels were found in the diseased group compared to the control group (Table 2).

Insignificant decreases in serum albumin and total cholesterol. In one report dealing with Noma horses and the effect of season, summer cholesterol and albumin results showed a reduction and were attributed to the effect of temperature on nutritional conditions (Ono et al., 2021). The insignificant change was found in C-reactive protein levels. CRP levels did not change with asthma, eczema, allergic rhinitis, food sensitization, aeroallergen sensitization, and any other sensitization (Yang et al., 2019).

CONCLUSION

Recurrent eczema in horses has been associated with an oxidative stress process manifested as an elevation in MDA level and a subsequent decrease in TAC and trace minerals (zinc and copper). Further studies regarding the effect of adding antioxidant compounds should be assessed.

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CONFLICT OF INTEREST

The authors declare that the present study has no conflicts of interest to disclose.

AUTHORS CONTRIBUTION

Mohamed el-sherif collected the samples , AlAA helal and Noha Salem made the lab.work, AlAA helal made the statistics, all authors wrote the manuscript. All authors declare that all the information in this manuscript is novel and has not published elsewhere

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