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ASSOCIATION BETWEEN GREEN FORAGE CONSUMPTION AND EQUINE MOTOR NEURON DISEASE; THE PROTECTIVE ROLE OF ANTIOXIDANTS

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Les facteurs diététiques associés au risque de maladie équine du motoneurone (EMND) ont été examinés. Dans le modèle de régression logistique, les variables représentant l'accès à l'herbe fraîche et au foin ont été associées à une diminution significative du risque d'être un cas de EMND. L'utilisation journalière de compléments minéraux dans la ration était associée à une augmentation significative du risque d'EMND. L'effet significatif protecteur d'une alimentation à base d'herbe fraîche pourrait être lié à l'apport de niveaux supérieurs d'antioxydants, et particulièrement de vitamine E (α-tocophérol). D'autres études sur ce sujet sont donc justifiées pour compléter l'influence de l'alimentation sur le risque d'EMND.

Equine motor neuron disease (EMND) is a spontaneous motor neuron disease characterized by generalized weakness and progressive muscle atrophy. Specifically, it is a neurodegenerative disorder of somatic lower motor neurons. Clinical signs may include a short-strided gait, lowered head and neck, frequent shifting of weight-bearing limbs, excessive recumbency, rapid onset of fatigue, sweating, muscle fasciculations, trembling, muscle atrophy, and weight loss (Cummings et al, 1990; Cummings et al, 1991).

Previous studies have demonstrated the association of several factors associated with the risk of EMND. Factors associated with increased risk of disease include age, breed, duration of residence on the farm, access to green forage, feeding complete pelleted or sweet feed, and supplementation with vitamins or minerals (de la Rua-Domenech et al, 1995; de la Rua-Domenech, 1996).

Evidence of ongoing oxidative stress in cases of EMND has been demonstrated (Cummings et al,1995; Divers et al, 1994). Additionally, an association between low plasma levels of vitamin E (α-tocopherol) and the risk of EMND has been confirmed. These data have led to the hypothesis that oxidative stress of dietary origin may contribute to the degeneration of somatic lower motor neurons in cases of EMND (de la Rua-Domenech, 1996a). The current study examines the association between three dietary factors and the risk of EMND. These factors are access to green pasture (hours/day), presence of hay in the diet, and the use of a dietary mineral supplement.

METHODS

A case-control study was carried out to analyze the contribution of dietary factors to the risk of EMND. Data from 96 EMND cases and 193 control horses were included in the analysis. The case group consisted of horses diagnosed with EMND and confirmed by postmortem or biopsy. These cases include horses seen at the College of Veterinary Medicine at Cornell University as well as referral cases from private clinics or other teaching hospitals. Of the 193 control horses, 93 were horses with neurologic disease other than EMND and confirmed by biopsy or postmortem; 100 additional control horses were horses without EMND, with a clinical diagnosis confirmed by postmortem or biopsy.

Information about the dietary factors was obtained through use of questionnaires and personal interviews. A logistic regression analysis was used to evaluate the significance of dietary factors on the risk of developing EMND. The three dietary factors examined in this analysis were GRASS, HAY, and MINERAL. The GRASS was measured as a linear response variable in units of hours of access to grass per day. The HAY was coded as a binomial response variable indicating presence or absence of hay in the daily diet. The MINERAL variable was coded as a binomial response variable indicating presence or absence of mineral supplements in the daily diet. The logistic model statement is shown in the equation below.

$$\text{Log}\,[\pi(x)/1-\pi(x)] = \alpha + \beta_i\,(\text{grass}) + \beta_j(\text{hay}) + \beta_k(\text{mineral})$$

RESULTS

Descriptive statistics for the three model variables are shown in Table I.

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Table I
Odds ratios and 95% confidence intervals for the association between EMND and grass, hay, and mineral supplement factors

Factor	Cases	Controls	Odds Ratio	95% Confidence Interval
Grass, zero hours per day	62	34	1.00	
Grass, one to twenty-four hours	34	159	0.12	NA
Hay , none	8	4	1.00	
Hay, present	88	189	0.23	(0.07 - 0.79)
Mineral supplement, none	60	141	1.00	
Mineral supplement, present	36	52	1.63	(0.97 - 2.74)

The model parameters are described in Table II.

Table II
Multivariate association between the hypothesized risk factors and the likelihood of equine motor neuron disease, as quantified by logistic regression analysis

Factor	Level	Regression Coefficient	Standard Error	Adjusted Odds Ratio	95% Confidence Interval
Grass (hours per day)	NA	-0.162	0.025	0.85	NA
Hay in diet	0	0.000		1.00	
Hay in diet	1	-1.912	0.8501	0.15	(0.03-0.86)
Mineral supplement	0	0.000		1.00	
Mineral supplement	1	0.665	0.309	1.945	(1.17-5.07)

For this model, access to grass and presence of hay in the diet were associated with a decreased risk of being a case. The use of mineral supplements in the daily diet was associated with increased risk of being a case of EMND.

DISCUSSION

The model suggests a decreased risk in horses with access to dietary grass and hay. The risk of EMND continues to decrease with increasing hours of access to grass per day. It is thought that this association between access to dietary grass and hay and decreased risk of development of EMND may be due to the presence of significant levels of vitamin E in these feeds.

It is known that green forages are excellent sources of vitamin E (Bauernfeind, 1980). Fresh forages can have five to ten times more vitamin E content than cereal grains. The majority of tocopherols are contained in the leaves of grasses. The level of vitamin E in forages decreases as plants reach maturity and flowering.

The stability of naturally occurring vitamin E is poor (Bauernfeind, 1980). Significant losses of vitamin E activity occur on processing and storage of forage crops. Similar losses in vitamin E activity occur during manufacturing and storage of finished feeds. For feed concentrates and complete pelleted feeds, the oxidation of vitamin E increases following grinding, mixing, addition of minerals, addition of fats, and pelleting. (Bauernfeind, 1980)

The importance of fresh green feed in the equine diet, as demonstrated by this model, may be further evidence to support the role of oxidative stress in the etiology of EMND.

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