DETECTION OF EXERCISE-INDUCED PULMONARY HEMORRHAGE IN COLOMBIAN CREOLE HORSES

Detección de hemorragia pulmonar inducida por ejercicio en Caballo Criollo Colombiano

Cristian Alejandro Castillo-Franz[1*]; Sara Restrepo-Valencia[1]; David Stiven García-Zapata [1]; Silvia Posada-Arias[1] and Juliana Mira-Hernández[1]

*[1]Research Group in Veterinary Medicine GIVET, Faculty of Administrative and Agricultural Sciences, Corporación Universitaria Lasallista, Carrera 51 118 sur Caldas, Antioquia, Colombia. *Corresponding author. Carrera 51 118 Sur 57, Caldas, Antioquia, Colombia. Tel.: +57 (4) 3201999 cricastillo@lasallistadocentes.edu.co*

ABSTRACT

Exercised-induced pulmonary hemorrhage (EIPH) is an alteration characterized by bleeding through the pulmonary vasculature as a consequence of cardiovascular changes during exercise. There is not much knowledge about the possible causes of it, despite the great quantity of studies in different breeds, mainly sport horses, but it is proposed that respiratory diseases or alterations may be involved and they may cause an increase in the intra-capillary pressure, leading to hemorrhage. However, the information available about this disease in the Colombian Creole horse (CCC) is scarce, which makes it difficult to know if it is involved in the decreased performance in competition of this horses. The aim of this study was to determine by endoscopic examination and bronchoalveolar lavage fluid (BALF), the presence of EIPH in 33 currently training CCC. All the animals were submitted to the same exercise routine and endoscopic examination was performed 90-120 minutes after exercise. The markers to consider an animal as positive were the presence of blood at the trachea and its confirmation by trachea-bronchial lavage and aspiration. From the total of examined animals7/33 (21, 2 %) were positive for EIPH.

Key words: Bronchoalveolar lavage fluid; endoscopy; equine; respiratory system.

RESUMEN

La hemorragia pulmonar inducida por ejercicio (HPIE) es una alteración que se caracteriza por el sangrado a través de la vasculatura pulmonar, como consecuencia de los cambios cardiovasculares durante el ejercicio. Son escasos los reportes acerca de las posibles causas, a pesar de que existe una gran cantidad de estudios en diferentes razas, principalmente caballos de deporte, pero se propone que alteraciones o enfermedades respiratorias pueden estar implicadas, causando un aumento en la presión intracapilar, lo que lleva a la presencia de hemorragia. Sin embargo, la información disponible sobre esta enfermedad en el Caballo Criollo Colombiano (CCC) es escasa, lo que hace difícil saber si está implicado en la disminución del rendimiento durante la competencia de estos caballos. El objetivo de este estudio fue determinar mediante un examen endoscópico y lavado broncoalveolar (LBA), la presencia de HPIE en 33 CCC que se encontraban bajo un régimen de entrenamiento. Todos los animales fueron sometidos a la misma rutina de ejercicio y el examen endoscópico se realizó 90-120 minutos después de finalizada la rutina de ejercicio. Los marcadores para considerar un animal positivo, fue la presencia de sangre en la tráquea y su confirmación por LBA. Del total de animales examinados 7/33 (21,2%) fueron positivos para HPIE.

Palabras clave: Lavado broncoalveolar; endoscopia; equinos; sistema respiratorio.

Recibido:10/03/2016 Aceptado: 31/05/2016

INTRODUCTION

Exercise-induced pulmonary hemorrhage (EIPH) commonly occurs in Thoroughbred and Standardbred racehorses worldwide [6], and it is the consequence of strenuous exercise [1]. The disease is characterized by pulmonary vasculature bleeding as a result of the cardiovascular changes during exercise [1]. It has been suggested that this rupture is caused by inflammatory disease that weakens the pulmonary capillaries [11]. In addition, other mechanisms have been proposed such as upper airway obstructions, coagulopathies, small airway disease, blood flow redistribution during exercise, altered blood viscosity, and mechanical trauma as a consequence of pressure waves propagated through the body due to the hooves striking the ground [2].

For many years decreased athletic performance had been the principal sign related with EIPH. However, it had been difficult to determine this relationship because there are many confounders involved such as concurrent use of furosemide in horses (*Equus caballus*), statistical methods, and the number of horses evaluated. Additional clinical signs are epistaxis (not always), labored breathing, coughing, or excessive swallowing [1].

Currently, the most common method of diagnosis of EIPH is endoscopic examination, associated to tracheal or bronchoalveolar lavage (BALF). The detection of blood in the trachea or large bronchi 30-120 (min) after strenuous exercise provides the definitive diagnosis. The findings are graded in a scale from 0 to 4, where 0 is assigned when no is detected and 4 when multiple coalescing streams of blood covering more than 90% of the tracheal surface are found. On the other hand, the presence of red cells, macrophages or hemosiderophages in tracheal or bronchoalveolar lavage also confirm the diagnosis when pure blood is not found by endoscopic examination [1,5].

The Colombian Creole horse (CCC) as an officially registered breed is not well known worldwide, only the Paso Fino Colombiano has become more popular in other countries. These horses are mostly used in national and international competitions (exhibitions), where they have to perform a series of rapid movements with several repetitions on a short period of time, this requires perfect athletic performance because the quality of the movements depends on it. Because the CCC had never been diagnosed with EIPH, and it is considered now a sport horse, the aim of this study was to assess the presence of EIPH in this breed.

MATERIALS AND METHODS

Thirty-three CCC of any gender and any sex, currently training, with a median age of five years were assessed. Horses were divided into groups according to the type of gate (categories previously established by the Colombian Federation of Equine Associations-FEDEQUINAS): Paso Fino Colombiano (1), Trocha Pura (12), Trocha-Galope (8) and Trote-Galope (12). The population description can be viewed in TABLE I.

TABLE I
DISTRIBUTION AND CATEGORY OF STUDIED POPULATION

Gait category	% (number of horses)	Age	% (number of horses)	Sex	% (number of horses)
Paso Fino	3.03% (1)	3 to 5 years	51.51% (17)	Female	51.52% (17)
Trocha	36.36% (12)	6 to 8 years	30.30% (10)	Male	48.48% (16)
Trocha y Galope	24.24% (8)	9 to 11 years	12.12% (4)		
Trote y Galope	36.36% (12)	12 years or more	6.06% (2)		

Endoscopic examination was performed 120 (min) after exercise using a Olympus® CF type 1T10L (Japan) fibre-endoscope introduced through one of the nostrils and passed down to the carina. The presence of blood was determined and BALF was collected with a Medex ® Levin 8 of 2 meters and 50 milliliters of sterile saline were passed . The presence of erythrocytes was considered as the positive marker for EIPH in this study. The grade of EIPH was classified with the scale afore mentioned. Horses that didn't accept the endoscope were sedated with xylazine (0.8 mg/kg intravenously).

RESULTS AND DISCUSSION

EIPH was detected in 21.2% (7/33) of the horses and all were classified as grade 1 (negative and positive EIPH endoscopic images from CCC can be viewed in FIGS. 1 and 2, respectively). Five (71.42%) of the positive animals were females and two (28.6%) were males. According to the type of gate, 14.28% (1/7) were Paso Fino Colombiano, 14.28% (1/7) Trocha-Galope, 28.6% (2/7) Trocha Pura and 42.86% (3/7) Trote-Galope. The obtained findings are not close to those previously reported in Thoroughbreds (55-68%) [9,12], racing Appaloosas (50%), racing Quarter Horses (62%) and three-day event horses (40%) [1]. On the other hand, the obtained results are closer to the lower detection of EIPH in Standard breeds (26%) and relatively closer to the 10 and 11% reported in pony club event horses and polo ponies, respectively [1]. Anatomical and physiological conditions of CCC may be similar to pony breeds, because of the size, origin and the kind of exercise they perform (not strenuous), these probably explains the relative similarity in EIPH detection.

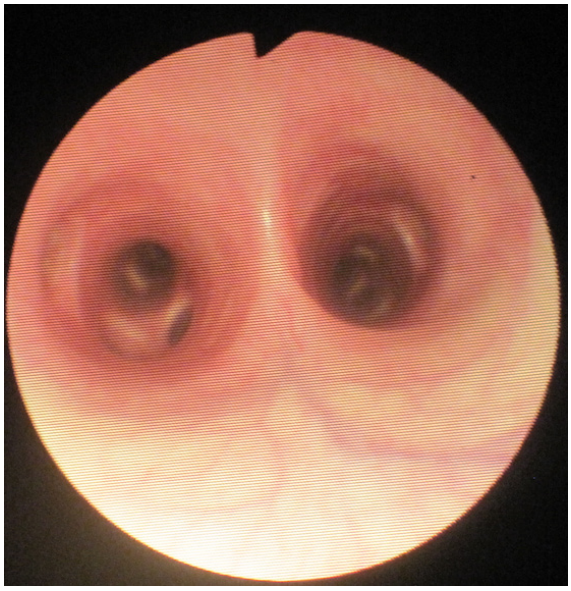

FIGURE 1. ENDOSCOPIC IMAGE FROM THE CARINA OF A EIPH NEGATIVE HORSE, 90 TO 120 MINUTES AFTER EXERCISE

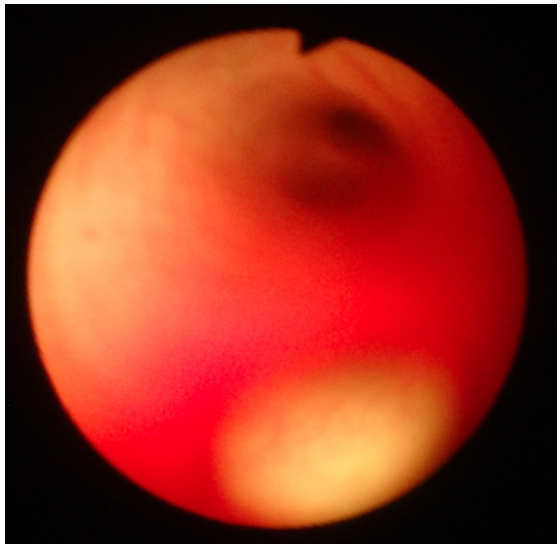

FIGURE 2. ENDOSCOPIC IMAGE FROM THE CARINA OF A EIPH POSITIVE HORSE, 90 TO 120 MINUTES AFTER EXERCISE.

When assessing BALF, moderate presence of erythrocyte (57.2%), abundant quantity of mucus (57.2%) and neutrophils (42%), were the characteristics most commonly found (TABLE II). Hemosiderophages were not detected in these BALFs, for this reason the presence of erythrocytes was considered as the positive marker for EIPH. The moderate presence of red cells demonstrates that EIPH in CCC is not yet a severe condition but that may be a prevalent condition (FIG. 3). Abundant quantity of mucus and high detection of neutrophils may indicate the presence of moderate respiratory disease, resulting in inflammation of the lower airways like recurrent airway obstruction, RAO), that was already diagnosed in CCC [3]. It has been experimentally demonstrated that horses with previous inflammatory processes are predisposed to develop EIPH after exercise [7], agreeing with results previously described by O'Callaghan et al. [11].

FIGURE 3. IMAGE OF A BALF FROM A EIPH POSITIVE HORSE.

In a study of risk factors for EIPH in Thoroughbred horses was reported a strong association between the presence of EIPH and environmental temperature (hot air), the presence of impurities in the trachea and the time between the end of the race and the endoscopic examination [9].On the other side, no association was found between the presence of EIPH and age, sex, speed race, the track surface or air quality, may be, the latter will only have influence if it is cumulative; these data is not consistent with other studies done previously [6]. Given the management conditions of most of CCC and the for competitions, it is possible to consider that the variation in temperature and air quality affect the presence of respiratory diseases as has been reported before in this breed [3].

Schroeder et al. [13] proposed that the hooves striking the ground during exercise may be a risk factor for EIPH. This theory

TABLE II

MEDIA, STANDARD DEVIATION, MEDIAN AND PERCENTILES 25 AND 75 OF EACH CELL TYPE OF BALF OF CCC STUDIED POPULATION

	Eosinophils (%)	Neutrophils (%)	Mononuclear cells (%)	Alveolar Macrophages (%)	Activated alveolar macrophages (%)	Epithelial cells (%)
EIPH Positive	1.14±1.57	42 (p25:18;p75:84)	4 (p25:2;p75:10)	20 (p25:2; p75:47)	8 (p25:5;p75:20)	3.71±3.77
EIPH Negative	2.26±3.05	20 (p25:10;p75:55)	18 (p25:58;p75:38)	16 (p25:5;p75:68)	8 (p25:2; p75:14)	2.73±3.95

*p= percentile

proposes that the impact of the forelimbs on the ground produces forces that target the lung, that can exacerbate pulmonary hemorrhage. This theory was supported by Newton et al. [10], in a study of 185 horses, where those of steeplechase presented more risk of epistaxis than running on flat tracks. All these conditions are not the same for the CCC, because the impact of the forelimbs on the floor does not have a marked effect on the chest of the animal during competition. It is still not clear the importance the association of the impact of the horse on the floor with the presence of EIPH, which leaves the theory of capillary rupture due to pulmonary hypertension during strenuous exercise as the most possible cause of EIPH [2,8]. However, EIPH can also occur in horses exposed to less severe or mild exercise, as this type of exercises unlike extenuating produces irregular inspirations and expirations, allowing the horse to take deeper breaths that affect the intrapulmonary pressure and facilitate capillary rupture [4, 8, 12]. However, Birks et al. [2] stated that the prevalence of EIPH is not related to the duration of exercise but it is related with intensity of the exercise.

CONCLUSIONS

The herein study demonstrates the presence of EIPH in CCC that are exposed to exercise conditions different from those of other sport horses studied worldwide. It also supports the importance of endoscopic examination associated with BALF for definitive diagnosis of EIPH in horses.

ACKNOWLEDGEMENT

We express our gratitude to the Research Vice-Presidency of Corporación Universitaria Lasallista Luis Fernando Garcés Giraldo for the financial support to this work.

BIBLIOGRAPHICS REFERENCES

[1] AINSWORTH, D.M.; CHEETHAM, J. Disorders of the Respiratory System. In: **Equine Internal Medicine**, 3rd.Ed. Elsevier Saunders, Riverport Lane, St. Louis, MO, USA. Pp 46-349. 2010.

[2] BIRKS, E.K.; DURANDO, M.M.; MCBRIDE, S. Exercise-induced pulmonary haemorrhage. **Vet. Clinics of North Amer. Equine Pract.** 19: 87–100. 2003

[3] CASTILLO, C.A.; MIRA, J.; SUÁREZ, A. Presencia de obstrucción recurrente de las vías aéreas en un grupo de caballos criollos colombianos con signología respiratoria. **Rev. Med. Vet.** 26:37-45. 2013.

[4] EPP, T.; MCDONOUGHF, P.; PADILLA, D.; GENTILE, J.; EDWARDS, K.; ERICKSON, H. Exercise-induced pulmonary haemorrhage during submaximal exercise. **J. of Equine Vet. Sci.** Suppl.36**:** 502-507. 2006.

[5] HINCHCLIFF, K.W.; KANEPS, A.J.; GEOR, R.J. Exercise-induced pulmonary haemorrhage. In: **Equine Sports Medicine and Surgery**. 2nd. Ed. Ed. Saunders Ltd, Edinburgh, UK. 1320 pp. 2014.

[6] HINCHCLIFF, K.W.; MORLEY, P.S.; JACKSON, M.A.; BROWN, J.A.; DREDGE, A.F.; O'CALLAGHAN, P.A.; MCCAFFREY, J.P.; SLOCOMBE, R.F.; CLARKE, A.F. Risk factors for exercise induced pulmonary haemorrhage in Thoroughbred racehorses. **Equine Vet. J.**42: 228-234. 2010.

[7] MCKANE, S.A.; SLOCOMBE, R.F. Experimental mild pulmonary inflammation promotes the development of exercise-induced pulmonary haemorrhage. **Equine Vet. J.**42: 235-239. 2010.

[8] MICHELOTTO, P.V.; MUEHLMANN, L. A.; ZANATTA, A. L.; BIEBERBACH, E.; KRYCZYK, M.; FERNANDES, L. C. Pulmonary inflammation due to exercise-induced pulmonary haemorrhage in Thoroughbred colts during race training. **The Vet. J.** 190: e3-e6. 2011.

[9] MORLEY, P. S.; BROMBEREK, J.L.; SAULEZ, M.N.; HINCHCLIFF, K.W.; GUTHRIE, A.J. Exercise-induced pulmonary haemorrhage impairs racing performance in Thoroughbred racehorses. **Equine Vet. J.** 47: 358-365. 2015.

[10] NEWTON, J. R.; ROGERS, K.; MARLINA, D. J.; WOOD, J. L. N.; WILLIAMS, R. B. Risk factors for epistaxis on British racecourses: evidence for locomotory impact-induced trauma contributing to the aetiology of exercise-induced pulmonary haemorrhage. **Equine Vet. J.** 37 (5): 402-411. 2005.

[11] O'CALLAGHAN, M.W.; HORNOF, W.J.; FISHER, P.E.; PASCOE, J.R. Exercise-induced pulmonary haemorrhage in the horse: results of a detailed clinical, post-mortem and imaging study. VII. Ventilation/perfusion scintigraphy in horses with EIPH. **Equine Vet. J.** 19: 423–437. 1987.

[12] PRESTON, S.A.; RIGGS, C.M.; SINGLETON, M.D.; TROEDSSON, M.H.T. Descriptive analysis of longitudinal endoscopy for exercise-induced pulmonary hemorrhage in Thoroughbred racehorses training and racing at the Hong Kong Jockey Club. **Equine Vet. J.** 47: 366-371. 2015.

[13] SCHROTER, R.; LEEMING, A.; DENNY, E.; BARATH, A.; MARLIN, D. Modelling impact-initiated wave transmission through lung parenchyma in relation to the etiology of exercise-induced pulmonary hemorrhage. **Equine Vet. J.** 30:34-38.1999.