

Incidence of exercise-induced pulmonary hemorrhage in racehorses in Puerto Rico¹

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ABSTRACT

Exercise-induced pulmonary hemorrhage (EIPH) is a very common condition in racehorses and is characterized by an alteration of the respiratory system. Depending on the magnitude, EIPH causes bleeding in lung passages making breathing difficult. EIPH is evaluated by endoscopies on a scale from 0 to 5, with 0 corresponding to no hemorrhage and 5 to a severe condition. In Puerto Rico, the only preventive measure used is the administration of a diuretic 4 h before the race. A data set was analyzed to determine factors associated with the incidence of EIPH and the preventive effect of the diuretic. The data was supplied by Equus PR, Center of Veterinary Medicine, and the factors considered were month of the year, sex (male or mare), distance of the race in meters (C1: 400 to 1,200; C2: 1,300 to 1,400; C3: > 1600), and the use or not of a diuretic. The randomly selected data of 2,632 endoscopies of racehorses running or not that were utilized represented 20% of the total endoscopies recorded in 2014. Of this number 1,377 were from horses within 1 to 3 h after the race, representing 52% of the total. A Chi-square test analysis was performed to determine the frequency of EIPH regarding the factors of month, sex, distance of the race, and use of the diuretic. Of the 1,377 animals, 488 presented some degree of EIPH, equivalent to 35% of the total sample. The percentage of affected horses suffering EIPH severity levels from 1 to 5 was 52.8, 23.6, 13.5, 7.3 and 2.8, respectively. The frequency and severity of EIPH were similar ($P = 0.435$) during the 12 months of the year. Males and mares also had similar ($P = 0.587$) incidence. Horses running shorter races (C1 and C2) had a higher ($P < 0.02$) incidence of EIPH than those running longer races (C3). The number of healthy horses, or those suffering from the condition, was similar ($P = 0.375$) regardless of diuretic use. In summary, 35% of the racehorses competing presented some level of EIPH; month of year and sex did not alter the incidence. Horses running shorter distances showed a higher incidence of the condition, and use of the diuretic was not effective as a preventive method for EIPH.

Key words: racehorses, lungs, bleeding, diuretic

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RESUMEN

Incidencia de hemorragia pulmonar inducida por el ejercicio en equinos de carreras en Puerto Rico

La hemorragia pulmonar inducida por el ejercicio (HPIE), es una condición muy común en equinos de carreras que se caracteriza por una alteración del sistema respiratorio. Dependiendo de la magnitud, la HPIE causa sangrado en los pasajes pulmonares dificultando la respiración. La HPIE se evalúa por endoscopias en una escala de 0 a 5; 0 correspondiente a ninguna hemorragia y 5 a una condición severa. En Puerto Rico la única medida preventiva contra la condición es la administración de un diurético 4 h antes de la carrera. Se analizó un conjunto de datos para determinar los factores asociados con la incidencia de HPIE y el efecto preventivo del diurético en equinos de carrera. Los datos fueron proporcionados por Equus PR, Centro de Medicina Veterinaria, y los factores considerados fueron mes del año, sexo (macho o hembra), distancia de la carrera en metros (C1: 400 a 1,200; C2: 1,300 a 1,400; C3: > 1,600), y el uso o no del diurético. Se utilizaron datos aleatoriamente seleccionados de 2,632 endoscopias de ejemplares de carreras que corrieron o no, representando el 20% de las endoscopias totales registradas en 2014. De este número, 1,377 se practicaron a animales entre 1 a 3 h después de la carrera, lo que representa el 52% del total. Se realizó un análisis de Chi-cuadrado para determinar la frecuencia de HPIE con respecto a los factores, mes, sexo, distancia de la carrera y uso del diurético. De los 1,377 animales, 488 presentaron algún grado de HPIE, equivalente al 35% de la muestra total. El porcentaje de los equinos que sufrieron la condición HPIE del grado de 1 a 5 fue 52.8, 23.6, 13.5, 7.3 y 2.8, respectivamente. La frecuencia y gravedad de HPIE fue similar ($P = 0.435$) durante los 12 meses del año. El macho y la hembra también tuvieron una incidencia similar ($P = 0.587$). Los caballos que corrieron carreras más cortas (C1 y C2) tuvieron una incidencia de HPIE mayor ($P < 0.02$) que aquellos que corrieron carreras más largas (C3). El número de animales sanos o los que sufrieron la condición fue similar ($P = 0.375$), independientemente del uso de diurético. En resumen, el 35% de los caballos de carreras que compitieron presentaron algún nivel de HPIE; el mes del año y el sexo no alteraron la incidencia. Los caballos que corrieron una distancia más corta mostraron una mayor incidencia de la afección y el uso del diurético no fue eficaz como método preventivo para HPIE.

Palabras clave: caballo de carrera, pulmones, sangrado, diurético

INTRODUCTION

Exercise-induced pulmonary hemorrhage (EIPH), a condition frequently experienced by horses during maximal exercise, is characterized by bleeding of the pulmonary vasculature (Art and Lekeux, 2005; Erickson et al., 1990). EIPH was first identified as epistaxis (bleeding from the nostrils) after intense exercise and a decrease in performance. Cook (1974) proposed that this blood originates in the lungs, and Birks et al. (1997) reported that EIPH occurs as a result of stress failure of pulmonary capillaries when horses exercise at high speed. Later studies showed that the bleeding originates in the alveoli, and

if the bleeding is intense, it can cover the alveoli space and appear in the nose sometimes leading to sudden death. High capillary transmural pressure contributes to vessel failure, a condition generated by a combination of high pulmonary arterial pressure and high negative inspiratory pleural pressure (West, 2000). Other authors define EIPH as the presence of blood in the tracheobronchial tree arising from the alveolar capillaries (Sweeney, 1990). The diagnosis of EIPH was based originally on clinical signs and necropsy. However, its causation was not proven until the respiratory tract was assessed, using a fiberoptic endoscope to examine the upper airway, alveoli alone, or combined with a tracheal wash, or by bronco-alveolar lavage cytology (Araya et al., 2005; Birks et al., 2003). Epp et al. (2006) and Viccino (2007) report that EIPH can occur in horses during less intense or submaximal exercise, suggesting that other factors may be involved in the pathogenesis of this disease.

In Puerto Rico, most racehorses are thoroughbreds, which are known for their speed and agility. However, this breed, primarily used for racing, is more likely to suffer several health conditions such as fractures in joints, gastric ulcers and EIPH. Annually, EIPH causes horse owners to incur costs from medical treatment, special training and veterinary services. Therefore, this condition represents a medical and economic hazard to the racing industry in Puerto Rico. There is no cure for EIPH or single specific factor that causes the bleeding. The only partial solution available in Puerto Rico and the U.S.A. is the administration of a diuretic, called furosemide, four hours before the race (Erickson et al., 1999). Furosemide draws water away from the lungs and keeps blood pressure from getting too high (Tobin et al., 2012). However, the efficacy of administering this diuretic has been very controversial in the racing industry. Some experts believe the drug does not function properly and others believe it's the solution for preventing EIPH. At present, there is no documentation available on the incidence of EIPH in racehorses in Puerto Rico and the factors associated with it. The authors know of no data pertaining to the usefulness of furosemide to prevent EIPH. Therefore, this study was designed to determine the incidence of EIPH in local racehorses, the potential factors associated with the condition (month of the year, sex of the animal, distance of the race) and use of the diuretic for its prevention.

MATERIALS AND METHODS

A retrospective analysis of data from the year 2014 at the Camare-ro racetrack, located in Canóvanas, Puerto Rico, was undertaken to

determine the incidence of EIPH in racehorses after running and potential factors associated with the condition. Data was supplied by Equus PR, Center of Veterinary Medicine⁵, which is the enterprise in charge of testing the physical condition of horses competing or not at the racetrack facility. This company has several veterinarians who perform the endoscopies and fill out a data sheet for each horse. The data include information on month of the year, sex of the animal, distance of the race, the use or not of the diuretic and the degree of severity of EIPH. The randomly selected data of 2,632 endoscopies of racehorses, running or not, that were utilized represented 20% of the total endoscopies recorded in 2014. Of this number 1,377 were obtained from horses within 1 to 3 h after the race, representing 52% of the total.

At the racetrack, an endoscopic respiratory evaluation is routinely performed on horses within 2 h after racing using an 8 mm fibre-endoscope introduced through one of the nostrils and passed down the carina. Severity of the condition is scored using values from 0 to 5, as follows: 0) no blood presence observed, 1) blood presence at the level of the carina, 2) blood presence at the level of the carina and trachea, 3) blood presence at the level of the carina, trachea and larynx, 4) traces of blood presence at the level of the carina, trachea and larynx, and 5) blood presence at the nose and at the level of the carina, trachea and larynx. The data set was analyzed using a Chi-square test to determine factors associated with the incidence of EIPH and the preventive effect of the diuretic furosemide. Factors considered were month of the year, sex (male or mare), distance of the race in meters (C1, 400 to 1,200; C2, 1,300 to 1,400; C3, > 1,600), and the use or not of the diuretic.

RESULTS AND DISCUSSION

Of the 1,377 horses analyzed after running a race, 488 presented some degree of EIPH, equivalent to 35% of the total sample. Related studies carried out elsewhere involved smaller numbers of observations. The present findings indicated a lower rate of incidence than those reported in several other studies. A retrospective survey, carried out at a Florida racetrack in 1984, found that out of 94 Appaloosa horses examined endoscopically between 30 and 90 min after racing, 52% exhibited some degree of EIPH (Hillidge et al., 1985).

⁵Company or trade names in this publication are used only to provide specific information. Mention of a company or trade name does not constitute an endorsement by the Agricultural Experiment Station of the University of Puerto Rico, nor is this mention a statement of preference over other equipment or materials.

Pascoe (1991) found that 85% of 42 racing horses presented EIPH, while Rojas et al. (1998) reported that 63% of thoroughbreds tested positive to the condition upon endoscopic examination. However, in a sample of 48 Chilean Patagonian Equines only 16.6% were diagnosed positive to EIPH (Tuemmers et al., 2014). In the present study, the percentage of the 488 horses suffering EIPH at each level, on a scale from 1 to 5, decreased as the severity of the condition increased (Figure 1).

The frequency and severity of EIPH were similar ($P = 0.435$) during the 12 months of the year (Table 1). Originally the authors hypothesized that during warmer months (June to August) the frequency and severity of EIPH would be higher. However, the data analyzed showed that the condition of EIPH was randomly distributed throughout the year. As for the effect of sex, males and mares had similar ($P = 0.587$) incidence of EIPH (Table 2), contrary to the expectation that male horses would have a higher tendency to EIPH than mares. Of the 488 horses showing EIPH, 245 were males, and 243 were mares. Reports in the literature are not conclusive concerning gender differences in EIPH incidence. Rojas et al. (1998), observed a higher percentage of the condition in geldings (72%) versus stallions, while other studies indicated a higher incidence in stallions (Pascoe, 1991). Araya et al. (2005) observed that 3 of 7 mares and 11 of 16 male horses of Chilean Criollo breeding were positive to EIPH. The observations of 4 of 6 stallions versus 7 of

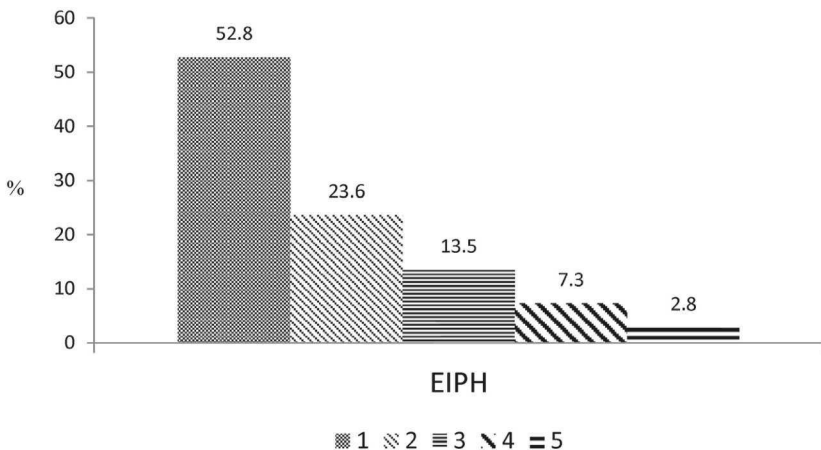


FIGURE 1. Percentage of the total incidence of EIPH found in racehorses in Puerto Rico at each level of severity (N= 488).

TABLE 1.—*Effect of month of the year on the frequency by degree of severity of EIPH in racehorses in Puerto Rico.*

Month	Number	Severity of EIPH					
		0	1	2	3	4	5
January	121	87	18	10	2	3	1
	%	71.90	14.88	8.26	1.65	2.48	0.83
February	118	81	20	7	6	3	1
	%	68.64	16.95	5.93	5.08	2.54	0.85
March	135	89	25	10	8	2	0
	%	65.93	18.52	7.41	5.93	2.22	0.00
April	113	75	20	8	7	2	1
	%	66.37	17.70	7.08	6.19	1.77	0.88
May	135	93	20	12	6	3	1
	%	68.89	14.81	8.89	4.44	2.22	0.74
June	115	84	19	3	4	3	2
	%	73.04	16.52	2.61	3.48	2.61	1.74
July	136	90	20	11	6	7	2
	%	66.18	14.71	8.09	4.41	5.15	1.47
August	111	65	22	11	5	5	3
	%	58.56	18.92	9.91	4.50	4.50	2.73
September	81	38	26	8	6	2	1
	%	46.91	32.10	9.88	7.41	2.47	1.23
October	96	61	18	8	7	2	0
	%	63.54	18.75	8.33	7.29	2.08	0.00
November	117	66	26	15	5	3	2
	%	56.41	22.22	12.82	4.27	2.56	1.71
December	92	56	22	11	3	0	0
	%	60.87	23.91	11.96	3.26	0.00	0.00

P = 0.435

16 geldings with bleeding gave a slight indication of the difference between the two-male groupings.

Present data show that horses running shorter races had a higher ($P < 0.02$) incidence of EIPH than those running longer races (Figure 2). It was expected that longer races would provoke more hemorrhage, yet the opposite result was found. Out of 467 total observa-

TABLE 2.—*Effect of sex on the frequency distribution of EIPH by degree of severity in racehorses in Puerto Rico.*

Sex	Number	Degree of severity					
		0	1	2	3	4	5
Mares	686	445	134	54	28	20	5
	%	68.47	19.53	7.87	4.08	2.92	0.73
Males	684	440	122	60	37	16	9
	%	64.33	17.84	8.77	5.41	2.34	1.32

P = 0.587

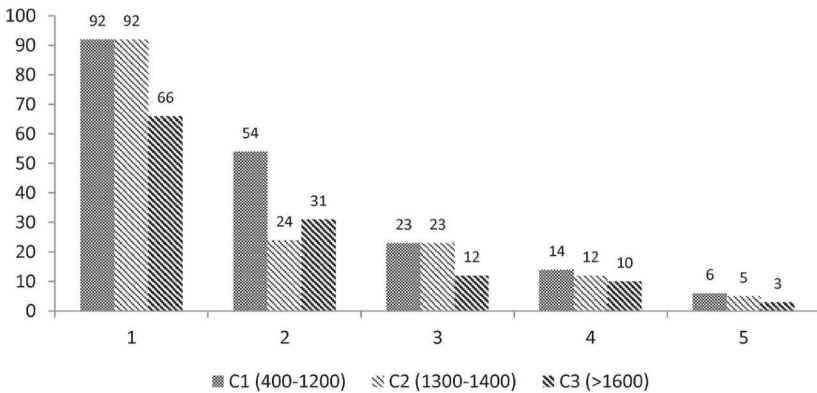


FIGURE 2. Effect of distance (m) of the race on the incidence (number of cases) by degree of severity (1 to 5) of EIPH in racehorses in Puerto Rico

tions, equines running distances of 400 to 1,200 m presented a total of 189 cases of EIPH (40%) with different degrees of severity, whereas corresponding figures for those racing 1,300 to 1,400 m (33%) and >1,600 m (26%), based on 156 and 122 cases, respectively, were lower. Perhaps the type and intensity of the race may affect the severity of bleeding. The present findings suggest that equines running shorter races may suffer more bleeding because of the impact of a greater change in speed and force exerted, even though over a shorter period of time. In related research and somewhat in contrast to the present results, upon comparing rodeo and training horses, a similar incidence and severity of EIPH was observed (Araya et al., 2005). In addition to the type and intensity of the sporting event, other factors such as longevity and genotype might well have an influence on the incidence of EIPH.

Currently, the only preventive measure used to control EIPH is that of the diuretic furosemide. However, Table 3 shows that, in this study, the proportion of horses remaining healthy and those suffering the

TABLE 3.—Effect of the use of a diuretic on the frequency distribution of EIPH by degree of severity (0 to 5) in racehorses in Puerto Rico.

Use of Diuretic	Number	0	1	2	3	4	5
Yes	1,208	784	214	104	58	35	13
	%	64.90	17.72	8.61	4.80	2.90	1.08
No	129	78	34	9	6	1	1
	%	60.47	26.36	6.98	4.65	0.78	0.78

P= 0.375

condition was similar ($P = 0.375$) regardless of diuretic use. These results may heighten the controversy over the usefulness of the diuretic to prevent EIPH in equines. Admittedly, one weakness of this report is the relatively few observations included on animals not treated with the diuretic (129) relative to a much greater number of observations on animals with treatment (1,208).

In summary, the present study indicates that 35% of the sample of equines in the racing industry in Puerto Rico presented some degree of the condition. The frequency of EIPH was basically equal during all times of the year and did not differ between male and female horses. However, those running shorter distances showed a higher incidence of the condition, and use of the diuretic furosemide was not effective as a preventive measure for EIPH.

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