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# Retrospective Analysis of Epistaxis Associated with Exercise-Induced Pulmonary Hemorrhage in Thoroughbred Race Horses in Korea

[1]Seong-Kyoon Choi, [2]Young-Jin Yang and [3]Gil-Jae Cho
[1]Division of NanoBio Technology, Laboratory of Biochemistry and Cellular Engineering,
Daegu Gyeongbuk Institute of Science and Technology (DGIST), 711-873 Daegu, Republic of Korea
[2]Veterinary Center, Korea Racing Authority, 427-711 Gwacheon, Republic of Korea
[3]College of Veterinary Medicine, Institute of Equine Medicine, Kyungpook National University,
702-701 Daegu, Republic of Korea

**Abstract:** This study was to investigate the frequency and risk factors of epistaxis associated with Exercise-Induced Pulmonary Hemorrhage (EIPH) in racing Thoroughbred horses at Seoul Race Park, South Korea, from 1996-2007. Epistaxis related to EIPH occurred in 752 (0.51%) horses of the 146,297 race starts. Of the 752 horses, 65 (8.6%) had a single recurrence and 9 (1.1%) had 2 recurrences. There was a tendency to higher frequency of bleeding at older (≥7, 0.88%) in age, female (0.56%) in sex, USA (0.77%) in origin, Autumn (0.62%) in season and 1,700-2,000 m (0.67%) in distance. Relationship did not exist between bleeding and respiratory diseases. About 624 (83%) race horses with epistaxis were an also-ran in performance. These results may provide the basic information needed to establish strategies for the prevention of epistaxis related to EIPH in race horses is associated with the age, sex and racing distance in Korea.

**Key words:** EIPH, frequency, thoroughbred race horse, epistaxis, Korea

## INTRODUCTION

Exercise-Induced Pulmonary Hemorrhage (EIPH) is a common disorder in high speed performing horses (Ferrucci *et al*., 2009). Regardless of whether horses have epistaxis or only have endoscopic evidence of blood in the airways following racing or exercise, this disease is called EIPH (Takahashi *et al*., 2001). Historically, EIPH was diagnosed by evidence of blood (epistaxis) at one or both nostrils. However, EIPH should now be considered ubiquitous in horses undertaking fast or intense exercise (Marlin, 2003). The range of the condition varies from horses showing only a small increase in the number of red blood cells detectable in the airways using techniques such as bronchoalveolar lavage to marked epistaxis. EIPH has most commonly been observed in Thoroughbred, Standardbred and Quarter Horse racing, however it has also been reported in virtually all equine breeds during different forms of fast or intense exercise (Hillidge and Whitlock, 1986; Speirs *et al*., 1982; Sweeney, 1991).

Studies have shown that its prevalence is related to the intensity of exercise rather than to duration of exercise or breed. Although, a significant association between the frequency of EIPH diagnosed by postexercise endoscopy and gender was not found in several studies (Hillidge and Whitlock, 1986; Sweeney, 1991), the increased frequency of epistaxis in female versus intact male horses was recently reported (Takahashi *et al*., 2001). Several researchers have reported an association between EIPH and age with the incidence apparently increasing in older horses (Pascoe *et al*., 1981; Sweeney, 1991; Takahashi *et al*., 2001). The incidence of epistaxis associated with EIPH in race horses reportedly varied from 0.2-13% (Cook, 1974; Hillidge *et al*., 1986; Pascoe *et al*., 1981). However, the incidence of EIPH diagnosed by endoscopic examination of the upper airway is now reported to be as high as 75-100% when the identifying criteria for diagnosing EIPH is extended to include the presence of blood in the trachea (Birks *et al*., 2002; Pascoe *et al*., 1981; Sweeney, 1991). If the diagnostic criterion of EIPH is the observation of erythrocytes or hemosiderophages, indicative of EIPH, in either tracheal wash or Bronchoalveolar Lavage (BAL) fluid, the incidence of EIPH is virtually 100% in all horses involved in intense exercise (Doucet and Viel, 2002).

Numerous causes and pathophysiological mechanisms have been proposed for EIPH, such as stress failure of the capillaries associated with elevated pulmonary arterial pressure, estimated pulmonary capillary pressures, high airway pressures, small airway disease, increased blood viscosity, mechanical stresses associated with respiration and locomotion (Roberts and Erickson,

**Corresponding Author:** Gil-Jae Cho, College of Veterinary Medicine, Institute of Equine Medicine,
Kyungpook National University, 1370 Sangyuk-dong, Buk-gu,702-701 Daegu, Republic of Korea

1999). Several factors may cause the pulmonary system to become heavily stressed to the point where capillaries fail (West *et al*., 1993). Various experiments have been performed to elucidate the cause of EIPH and a variety of findings including age, racing distance and sex have been reported. The purpose of this study was to comparison with physical circumctances and frequency and identify the factors associated with the cause of epistaxis related to EIPH in Thoroughbred race horses in Korea.

## MATERIALS AND METHODS

Race start information was obtained from 146,297 racing Thoroughbred horses at Seoul Race Park, South Korea, from 1996-2007. The record for each race start included information on the age (2-6 or ≥7 years old), sex (sexually intact male, female or gelding), racing distance (≤1,400, 1,700-2,000 and 2,300 m), origin and season. After the nose twitched, all horses that had an evidence of blood were examined with an endoscopy (Olympus, Japan) within 30 min by a veterinarian for evaluation of the upper respiratory tract after racing. If horses have endoscopic evidence of blood in the airways, EIPH-related epistaxis was diagnosed. The horses that had repeated episodes of epistaxis associated with EIPH were included in the statistical analysis. The frequency of occurrence of EIPH-related epistaxis was calculated for each factor by dividing the number of cases by the number of starts. The possible correlation between EIPH and age, sex and origin was studied with multivariate analysis. Values <5% ($p<0.05$) were considered as statistically significant.

## RESULTS AND DISCUSSION

Data was obtained from 146,297 Thoroughbred race starts. The frequency and risk factors of epistaxis associated with EIPH among horses racing in Korea between 1996 and 2007 are shown in Table 1. Epistaxis related to EIPH occurred in 752 (0.51%) horses of the 146,297 starts. Of the 752 horses, 65 (8.6%) had a single recurrence and 9 (1.1%) had 2 recurrences. Epistaxis was detected following 0.43% race starts for races ≤1,400 m long, 0.67% race starts for races between 1,700-2,000 m long and 0.49% race starts for races 2,300 m long. There was a tendency to higher frequency of bleeding at older (≥7, 0.88%) in age, female (0.56%) in sex, USA (0.77%) in origin, Autumn (0.62%) in season. Relationship did not exist between bleeding and respiratory diseases. The results of performance in race horses with epistaxis related to EIPH is shown in Table 2. Of the 752 horses, 624 (83%) were an also ran after finishing each race.

Table 1: Frequency and risk factors of epistaxis associated with EIPH in racing Thoroughbred horses at Seoul Race Park from 1996-2007

| Variables | Categories | No. of horse in race | No. of epistaxis horse (%) |
|---|---|---|---|
| Age | 2 | 8,324 | 23 (0.28) |
| | 3 | 42,535 | 169 (0.39) |
| | 4 | 43,794 | 193 (0.44) |
| | 5 | 28,184 | 175 (0.62) |
| | 6 | 14,093 | 109 (0.77) |
| | ≥7 | 9,367 | 83 (0.88) |
| Sex | Female | 73,706 | 416 (0.56) |
| | Male | 35,898 | 137 (0.38) |
| | Gelding | 36,693 | 199 (0.54) |
| Origin | Korea | 74,868 | 323 (0.43) |
| | New Zealand | 29,708 | 182 (0.61) |
| | Australia | 24,191 | 123 (0.51) |
| | USA | 14,049 | 109 (0.77) |
| | Japan | 1,329 | 8 (0.60) |
| | Other | 2,152 | 7 (0.33) |
| Season | Spring | 39,111 | 205 (0.52) |
| | Summer | 35,290 | 128 (0.36) |
| | Autumn | 37,771 | 235 (0.62) |
| | Winter | 34,125 | 184 ((0.54) |
| Racing distance | ≤1,400 | 95,407 | 410 (0.43) |
| | 1,700-2,000 | 50,277 | 339 (0.67) |
| | 2,300 | 613 | 3 (0.49) |
| Total | Thoroughbred | 146,297 | 752 (0.51) |

Table 2: Results of performance in 752 race horses with EIPH-related epistaxis after finishing each race

| No. of 1st place (%) | No. of 2nd place (%) | No. of 3rd place (%) | No. of also ran (%) |
|---|---|---|---|
| 27 (3.6) | 53 (7.0) | 48 (6.4) | 624 (83.0) |

EIPH is a condition afflicting nearly all race horses during high intensity running (Kindig *et al*., 2001). The clinical findings related to EIPH are often quite vague and some horses show no signs but others may swallow during racing and then cough, severe or have a sudden decrease in running speed. In many cases, these signs may be overlooked and simply attributed to a poor performance. Extremely rarely, however the haemorrhage is severe enough to cause collapse, severe distress or death.

Newton *et al*. (2005) reported that the risk of epistaxis was significantly increased for hurdle and steeplechase race types compared to flat and national hunt flat races. The type of race in Korea is flat with sand track. In the present study, the frequency of epistaxis related to EIPH was detected 0.51% after racing. This is lower than the frequencies reported in other studies (Hillidge *et al*., 1984, 1986; Kim *et al*., 1998; Pascoe *et al*., 1981; Pfaff, 1976; Raphel and Soma, 1982). However, this is higher than Japan (0.13%) and South Africa (0.2%). These differences may explain the checked time after the finish of each race and type of race. There have been reports that geographic and environmental factors (type of turf, condition of race track) influence the frequency of epistaxis related to EIPH. The rate of recurrence of epistaxis among 752 horses in this study was 9.8%, 65 (8.6%) horses had a single

recurrence and 9 (1.1%) horses had 2 recurrences. Presently, horse in which epistaxis is observed at a race cannot start again for at least 1 month under the rules of the Korea Racing Authority and horses are not permitted to race if horses with EIPH occured >2 recurrences in Korea. The frequency of epistaxis related to EIPH in race horses is associated with the horse's age, sex and racing distance in the present study. Previous reports indicate that the frequency of epistaxis increased with the horse's age and female (Hillidge *et al*., 1986; Lapointe *et al*., 1994; Raphel and Soma, 1982). The frequency of epistaxis was highest during Autumn (0.56%) and 1,700-2,000 m (0.67%) in distance in the current study. However, a relationship between temperature and humidity of the race track in condition was not detected. Raphel and Soma (1982) reported that frequency of EIPH increased with distance raced ranging from 600-1600 m. It is supposed to prevent horses from epistaxis that decrescent performance horses should not be entering long distance. Newton *et al.* (2005) reported that horses with epistaxis were significantly more likely to have a poorer finishing position than those without blood at the nostrils. In this study, of the 752 horses with epistaxis related to EIPH, 624 (83%) were an also ran after fishing each race. These results suggests that moderate to severe EIPH is thought to be a contributing factor in poor performance. And the prevention of EIPH will be needed to strengthen the exercise tolerance and the capacity of the lungs in race horses. There are no drugs licensed for the treatment of EIPH. Presently diuretic furosemide which acts to increase water loss in urine and so decrease the blood volume and blood pressure is routinely used. The use of furosemide is not allowed in horses in Korea Racing Authority races. Lee *et al.* (2007) reported that the best time for furosemide administration will be 30 min before the racing in order to prevent EIPH. Cook (1974) reported that blood seen in the nostrils and trachea is most likely originated from lung. O'Callaghan *et al.* (1987) suggested that EIPH resulted from rupture of pulmonary capillaries that were weakened by inflammatory diseases.

## CONCLUSION

The mechanisms of EIPH cannot be easily explained because of various reasons. Further mechanistic studies will be needed to prevent the EIPH-related epistaxis in race horses.

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