

Exercise-Induced Pulmonary Haemorrhage in Horses after Different Competitive Exercises

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Summary

Six different groups of horses were examined to determine the frequency of exercise-induced pulmonary haemorrhage (EIPH) following different competitive exercise. The prevalence of EIPH in each group is as follows: 65.6% to 75.4% Thoroughbred flat dirt racing, 67.7% steeplechase racing, 14.3% flat turf racing, 66.7% timber racing, 38.3% to 65.6% flat training gallop, 40% National Cross-Country Event, 10% USPC Cross-Country Event and 0% 100 mile endurance race. Examination of the data shows that there is no obvious correlation between the speed and the distance and the resulting prevalence of EIPH. However, it appears that speeds greater than 240 metres/minute are necessary for a horse to have EIPH. The study also showed that EIPH does occur in mixed breed animals competitively exercised.

Introduction

The frequency of epistaxis following competitive horse racing was historically thought to be between 0.25% and 2.5% on the basis of earlier reports (Bourke 1974; Cook 1974; Pfaff 1950; Pfaff 1976; Johnson *et al.*, 1973). However, a study by Pascoe *et al.* (1981) using a flexible fiberoptic endoscope to examine Thoroughbred horses after they had raced reported that 43.8% of the horses examined revealed blood in the trachea. This confirmed the suggestion of Cook (1974) that the lungs were the source of the blood, and Pascoe *et al.* (1981) referred to the condition as exercise-induced pulmonary haemorrhage (EIPH). A recently published report by Raphael and Soma (1982), using a similar protocol to Pascoe, found a similar high prevalence of EIPH in Thoroughbreds following racing and training gallops. There have been no prior reports on the prevalence of EIPH in non-Thoroughbred horses. This paper includes the results of endoscopic examination carried out after a variety of different competitive events.

Materials and Methods

Six different groups of horses were examined to determine the frequency of EIPH following exercise (Table 1). The first and most extensive survey was conducted during a racing

meeting in October 1980. During 15 consecutive racing days, 191 horses were examined after they had been raced over distances of 1.2 to 1.7 km, and 107 horses were examined after they had undertaken a training gallop over distances of 0.6 to 1.6 km.

TABLE 1. Prevalence of EIPH in horses after different competitive events.

Group	% EIPH	n	Breed	Competitive exercise	Distance (km)	Average speed (m/min.)
1a	75.4	191	Thoroughbred	Flat racing, dirt track	1.2-1.7	1050
1b	38.3	107	Thoroughbred	Flat training gallops, dirt track	0.2-1.6	1020
2	65.6	32	Thoroughbred	Flat training gallops, dirt track	0.2-1.6	1020
3a	66.7	31	Thoroughbred	Steeplechase racing, turf track	2.1-4.0	960
3b	14.3	14	Thoroughbred	Flat racing, turf track	2.1	900
3c	66.7	3	Thoroughbred	Timber racing, turf track	4.8	720
4	40.0	5	Thoroughbred-Cross	National Level Cross-Country Event	16.0	520
5	10.0	40	Mixed	USPC Cross-Country Event	4.1	360
6	0	10	Mixed	100 Mile Endurance Race	160.0	240

Two more groups of Thoroughbred horses were examined under competitive or near competitive conditions. The groups included 32 Thoroughbred horses examined after a training gallop over 0.6 to 1.2 km and 48 Thoroughbred horses in competitive steeplechase, flat and timber races. Thirty-one of these horses were racing in steeplechases (over brush fences) over distances between 2.1 to 4.1 km, 14 horses in a 2.1 km flat race and 3 horses in a 4.8 km timber race over solid wood jumps. The fourth and fifth groups of horses included five Thoroughbred cross-bred horses examined after a 16 km endurance phase in a National level three-day event and 40 ponies and horses of different breeds examined after a United States Pony Club (USPC) cross-country event over 32 km. The last group included ten horses of different breeds (Arab, Appaloosa, Quarter Horse and Grade) examined after completing a 160 km endurance ride.

To evaluate the repeatability of endoscopic findings of EIPH, an additional study was conducted in which 76 Thoroughbred horses included in the first group were examined endoscopically on two separate occasions after racing or after a training gallop under similar conditions (i.e. same distances raced or exercised, same pre-race medications).

All trainers and owners were invited to participate in these surveys but had no influence on which horses were examined. The only horses that were excluded were those that could not be examined for logistical reasons. In the first study, the horses were examined at state detention barns. All horses were examined within two hours of completion of the competition or training. In all other competitions, the horses were examined in their stalls. The technique for endoscopic examination was similar to that previously described (Pascoe *et al.*, 1981), except that a longer (140 cm) flexible fiberoptic endoscope was used (Raphel and Soma, 1982). The degree of haemorrhage visible in the trachea was graded on a basis of width of the stream of blood in the trachea (Pascoe *et al.*, 1981). The data were analyzed statistically using the chi square (χ^2) test for association (Snedecor

and Cochran, 1978). The level of significance selected was 5%. The level of agreement between repeat examinations was analyzed statistically using the statistic kappa (Fleiss 1981).

Results

Group 1. The ages and sexes of the horses examined were consistent with the overall population of horses that were racing during the period of this survey based on a χ^2 test for homogeneity. EIPH-positive horses were those horses with evidence of haemorrhage on endoscopic examination of the trachea, and there were various degrees of haemorrhage in the tracheal lumen. There was no horse that had evidence of concurrent haemorrhage from other sites in the upper respiratory tract.

Of 191 Thoroughbred horses examined after racing, 144 (75.4%) were EIPH-positive (Table 1). Only 13 (9.0%) of the EIPH-positive horses had blood at the nostrils. Of 107 horses examined after training gallops, 41 (38.3%) were EIPH-positive and only 1 (2.2%) showed blood at the nostrils.

The amount of haemorrhage seen during the endoscopic examination varied from drops of blood on the mucosal surface of the trachea to profuse haemorrhage into the tracheal lumen. The majority of the horses had thick streams of blood on the ventral aspect of the trachea and blood extended from the proximal trachea to the carina and widened distally.

An association between EIPH and the horse's age was demonstrated, with a significant increase in the frequency of EIPH as the age of the horse examined increased in both the racing ($\chi^2 = 19.59$, $p < 0.05$) and training ($\chi^2 = 17.05$, $p < 0.05$) population (Fig. 1). No association between the sex of the horse and the frequency of EIPH was found either after racing ($\chi^2 = 1.26$, $p > 0.05$) or training ($\chi^2 = 1.91$, $p > 0.05$) (Fig. 2). There was a statistically significant association between the distance raced ($\chi^2 = 6.58$, $p < 0.05$) or trained ($\chi^2 = 6.47$, $p < 0.05$) and the frequency of EIPH, indicating that the further the horse raced or trained, the more likely it was to bleed (Fig. 3). No relationship was found between EIPH and the finishing position in a race.

FIGURE 1. Relationship of the frequency of EIPH to age of horses examined endoscopically after racing or after a training gallop.

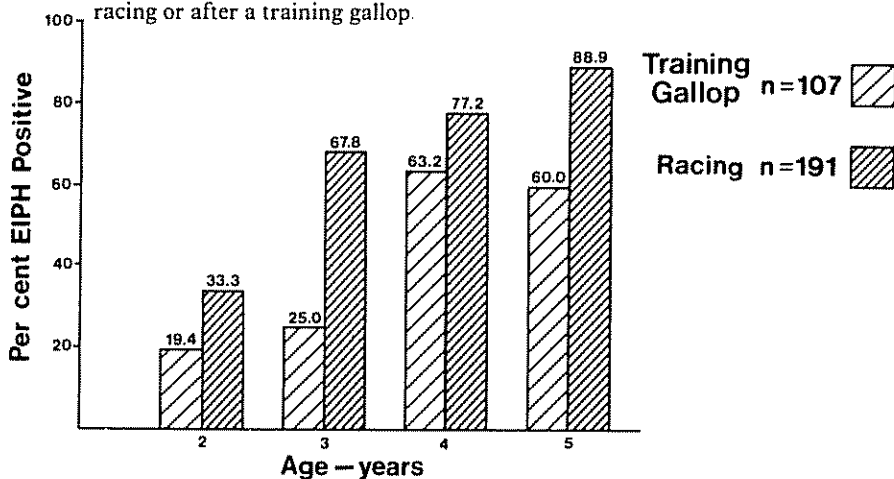


FIGURE 2. Relationship of the frequency of EIPH to sex of horses examined endoscopically after racing or after a training gallop

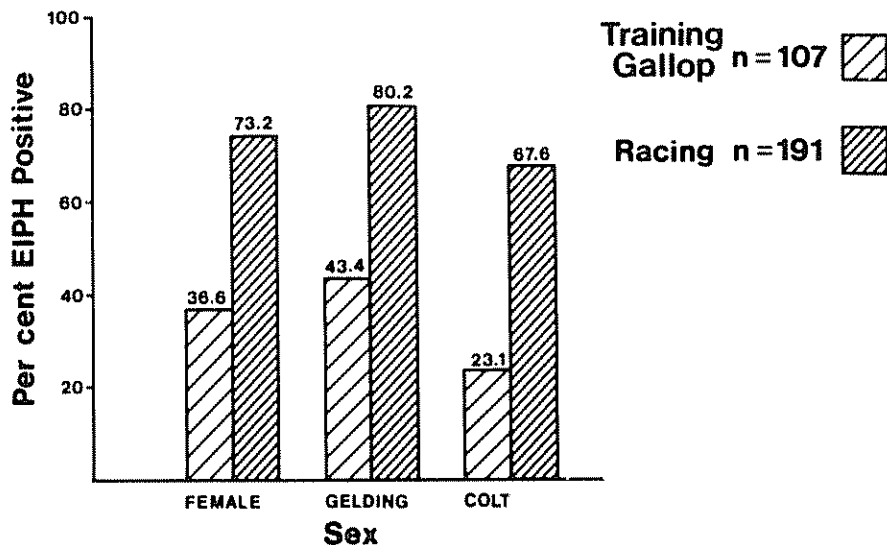
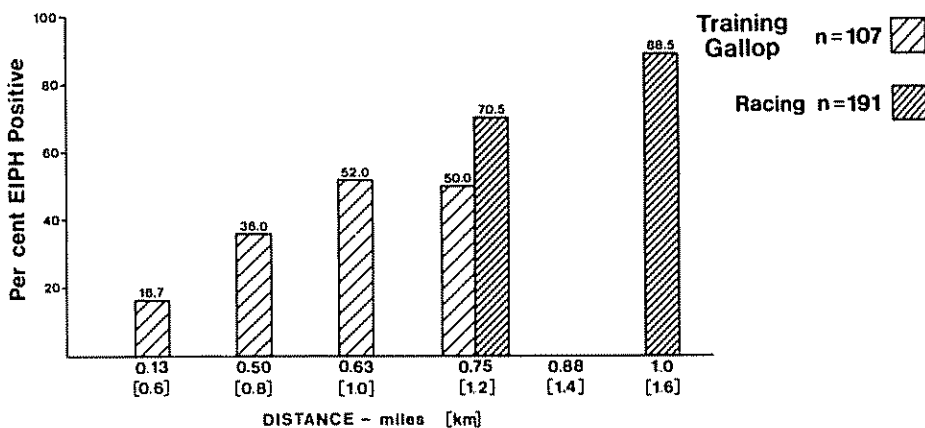


FIGURE 3. Relationship of the frequency of EIPH to distance raced or trained of horses examined endoscopically after racing or after a training gallop.



Group 2. Of the 32 Thoroughbreds examined after training, 21 (65.6%) had evidence of EIPH. None of the horses had blood at the nostrils.

Group 3. Of the Thoroughbreds examined at the Fair Hill Meet following steeplechase, flat and timber racing, 67.7% (21/31), 14.3% (2/14) and 66.7% (2/3) had EIPH, respectively (Table 1). Of the EIPH-positive horses in the steeplechase, flat and timber races, 14.3%, 0% and 100%, respectively, had blood present at the nostrils.

Group 4. Of the five horses examined after the Cross-Country Event, 40% (2/5) had evidence of EIPH. One had blood present at the nostrils.

Group 5. Of the 40 ponies and horses of different breeds examined after the USPC event, 10% (4/40) had EIPH. This included a 9-year-old Quarter Horse gelding, a 13-year-old Quarter Horse gelding, an 11-year-old Arabian mare and a 21-year-old Appaloosa mare. None of these horses had blood present at the nostrils.

TABLE 2. Results of two endoscopic examinations of 76 Thoroughbred horses under similar conditions.

Repeated examination	Initial examination		Sub-total
	EIPH-positive	EIPH-negative	
EIPH-positive	32	10	42
EIPH-negative	8	26	34
Total	40	36	76

$\kappa = 0.523$; $SE \kappa = 0.115$, $z = 4.55$, so $p < 0.0001$.

Group 6. Of the ten horses examined after the 160 km endurance ride, none showed any evidence of EIPH endoscopically or at the nostrils.

Of 76 Thoroughbred horses examined to evaluate repeatability of endoscopic findings of EIPH after racing or after a training gallop, 58 horses had identical endoscopic findings (Table 2). The statistic kappa (κ) was used to determine the measurement of exercise agreement between the two observations, as opposed to chance ($\kappa = 0.523$; $p < 0.0001$).

Discussion

For a review of EIPH in the horse, the reader is referred to several recent articles (Pascoe *et al.*, 1981; Pascoe 1982; Raphel and Soma, 1982). Although there has been considerable speculation that horses involved in exercise other than flat racing experienced pulmonary haemorrhage, it was only recently that there was a report of prevalence of EIPH in Thoroughbred horses following training gallops and turf, timber and steeplechase races (Raphel and Soma, 1982). The results of this study show that EIPH is not related to the breed of horses but can occur in mixed breed animals exercised competitively, and there appears to be some correlation with the speed of exercise.

The exact physiological conditions necessary to cause EIPH have yet to be defined. However, from previous reports it is obvious that even a distance as short as 600 m at a speed of approximately 1020 metres/minute can cause EIPH (Raphel and Soma, 1982). Examination of the data from this study shows that there is no obvious direct correlation between the speed and the distance and the resulting prevalence of EIPH. However, it appears that speeds greater than 240 metres/minute are necessary for a horse to have EIPH, as ten horses racing 100 miles at speeds ≤ 240 metres/minute did not have EIPH.

Although the prevalence of EIPH in the mixed breeds of animals competing in the Pony Club Event was lower than in racing Thoroughbreds, its occurrence was noteworthy. The four horses that bled were pleasure animals pastured and not exposed to the

confined environment of horses stabled at the racetrack. Therefore, the authors feel that the horses' environment may not be a major factor associated with EIPH.

The higher frequency of haemorrhage in the older competitive animal (Raphel and Soma, 1982) indicates that there may be cumulative effects of pulmonary damage.

This study has shown that EIPH does occur in mixed breed animals competitively exercised at speeds greater than 240 metres/minute. How the factors of speed and distance relate to the pathogenesis of EIPH is not known.

Acknowledgement

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