

## Exercise-Induced Pulmonary Haemorrhage in Horses

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### Summary

*During the course of a Hong Kong Thoroughbred racing season, 485 individual horses were examined with a flexible endoscope post race in order to detect the presence or absence of blood in the proximal trachea. Of these, 29 had bled from their nostrils. The blood at the nostrils and proximal trachea comes from the lungs and is known as exercise-induced pulmonary haemorrhage (EIPH). Of the runners, 46.8% had EIPH, but in those examined more than three times, an incidence of 82% was recorded. Post-mortems carried out on 117 horses that had been trained in Hong Kong showed that 82% had signs of previous haemorrhage in the posterior lobes of the lung. Histological examination revealed that 96% of horses had evidence of old alveolar haemorrhage and bronchiolitis.*

*The endoscopic examination did not assist in predicting whether an animal would bleed from the nostrils at its next start or in assessing the degree of lung haemorrhage, but results did reveal that EIPH had an effect on performance and increased with age.*

### Introduction

The appearance of blood at the nostrils of horses during or after a race is known as epistaxis or 'bleeding'. In Hong Kong this phenomenon is regarded as a serious condition, as horses can collapse or even die as a result of the haemorrhage. Under Hong Kong Jockey Club rules any horse that bleeds twice is automatically barred from racing, and last season 12% of retirals (16 of 129) could be traced to this rule.

It is now known that the haemorrhage arises from the lungs and occurs in a large proportion of horses during racing, although blood is seldom present at the nostrils. Pascoe *et al.* (1981) used the term exercise-induced pulmonary haemorrhage (EIPH) to describe this phenomenon.

A study began at the beginning of the 1981 season to determine the extent of EIPH and to examine the lungs of retired racehorses, grossly and histologically, in order to establish whether there was a relationship between EIPH and lung pathology.

### Materials and Methods

The horses examined were those sent by the race meeting stewards to a security area

where urine samples were collected for subsequent analysis. The horses, which were mostly geldings, had raced on the flat over distances between 1000 and 2400 metres.

The method used to detect EIPH was similar to that of Pascoe *et al.* (1981) and consisted of using a flexible endoscope to examine the proximal trachea for the presence of blood, 30 to 90 minutes post race.

The horses were graded into two categories, according to the severity of the haemorrhage: 1. minor bleeders which were characterized by a thin streak of blood on the floor of the trachea, 2. serious bleeders which had a broad streak with or without splashing on the larynx.

During the season, 992 examinations were made after racing, representing 21.4% of race starters (4635). In all, 62.7% (485 out of 774) of horses that raced in the season were examined at some stage, including all that bled from the nostrils.

Results were evaluated for the incidence of EIPH with regard to age, distance, finishing position in a race, trainers, location of race-track, location of stables, type of track (grass or sand) and state of going. Horses were also examined on several occasions in order to assess whether EIPH was repeatable and predictable.

*Autopsy.* During the period from April 1981 to August 1982 post-mortems were carried out on 117 race horses which had been retired. These were from two groups: 46 from racing stables and 71 from retirement homes. The latter had all raced but had been retired and sent to various establishments to be used as hacks. Of these, 25 had been out of training for a minimum period of 12 months.

Lung samples were taken at random from 47% of autopsies (55 out of 117) and subjected to a histological examination. Five sites were chosen for each lung: apical, central dorsal, posterior dorsal, central diaphragmatic and anterior basal.

TABLE 1. Incidence of EIPH according to age.

Age	Total sampled	Minor EIPH % *	Serious EIPH % †	Total EIPH %
2	1	0	0	0
3	153	24.2	3.3	27.5
4	204	33.3	9.8	43.1
5	238	39.5	11.3	50.8
6	192	32.8	14.6	47.4
7	102	33.3	26.5	59.8
8	50	42.0	16.0	58.0
9	37	37.8	21.6	59.5
10	10	40.0	30.0	70.0
11	5	40.0	20.0	60.0
Total	992	34.0	12.8	46.8

\* Thin streaks or spots of blood.

† Broad streaks and blood splashing on to larynx.

### Results

Of the 992 examinations made post race, 46.8% showed evidence of EIPH, but the incidence in the 485 individual horses examined was 62.5% by the end of the season. There were 51 horses that had been examined between four and seven times, and 82% of these showed the presence of blood at least once. Blood at the nostrils was found in 29 horses which represented 3.9% of the total population and 0.63% of total race starters.

The incidence of EIPH with respect to age, placing in a race and distance is seen in Tables 1, 2 and 3. There was a significant increase of the incidence of EIPH with age and placing ( $p < 0.001$ ), while distance, location of stables, trainers, going, location of track and track type (grass or sand) had no effect. Table 4 shows the results of horses examined four times and demonstrates that EIPH could not be detected consistently at the proximal trachea. The effects of environmental temperature and relative humidity are currently being examined to see whether they have any significance.

TABLE 2. Incidence of EIPH according to placing.

Placing	Total sampled	Minor EIPH %	Serious EIPH %	Total EIPH %
Winning group (1-3)	756	33.7	10.2	43.9
Losing group (4-14)	236	34.7	21.2	55.9
Total	992	34.0	12.8	46.8

TABLE 3. Incidence of EIPH according to distance.

Distance (km)	Total sampled	Minor EIPH %	Serious EIPH %	Total EIPH %
1.0	162	37.0	14.2	51.2
1.1	16	31.3	6.3	37.5
1.2	246	37.0	11.4	48.4
1.4	128	23.4	13.3	36.7
1.5	12	25.0	16.7	41.7
1.6	242	33.5	13.6	47.1
1.8	119	31.9	13.5	45.4
2.0	20	45.0	10.0	55.0
2.2	40	47.5	12.5	60.0
2.4	7	14.3	—	14.3
Total	992	34.0	12.8	46.8

TABLE 4. Horses showing EIPH when examined on four occasions (28).

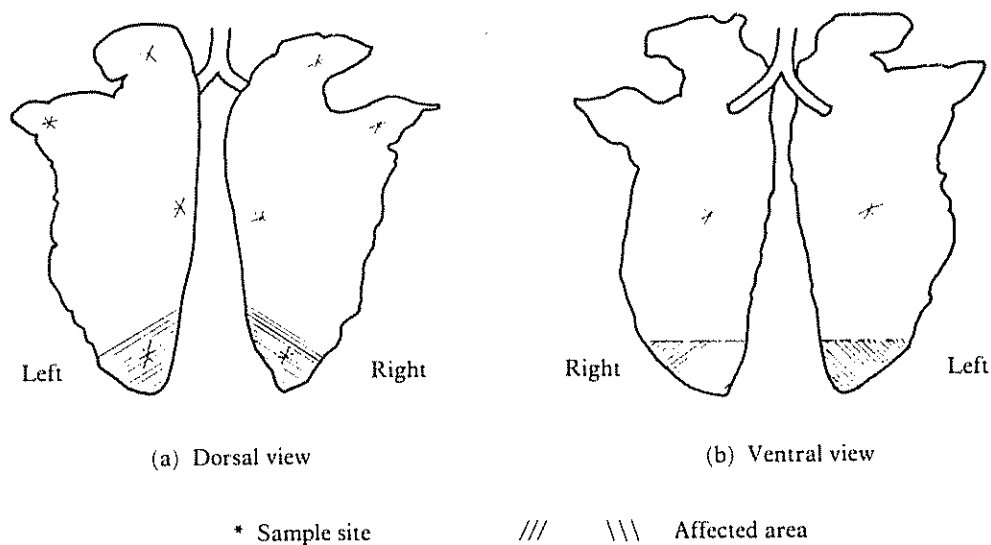
Incidence	0/4	1/4	2/4	3/4	4/4
No. of horses	7	3	7	7	4

Autopsy results are shown in Table 5. Evidence of old pulmonary haemorrhage was noted as bilateral, near-symmetrical, abnormal discolouration in the posterior lobes (Fig. 1).

TABLE 5. Autopsy and histology results.

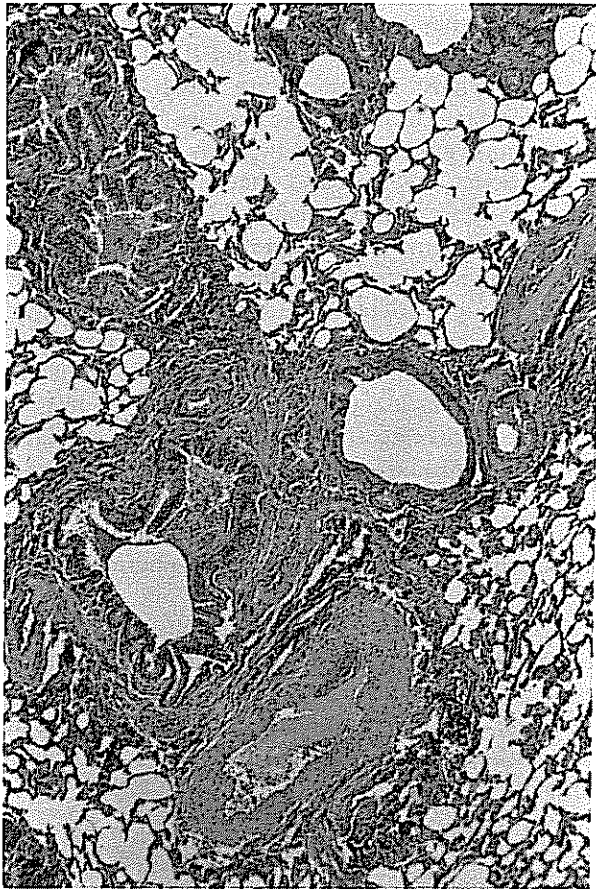
Horses direct from	Racing stables	Retirement stables	Total	Horses in retirement stables for over 12 months
Autopsies	46	71	117	25
Gross haemorrhage	35 (76%)	61 (86%)	96 (82%)	22 (88%)
Histology	22	33	55	10
Microscopic bronchiolitis	22 (100%)	31 (94%)	53 (96%)	9 (90%)
Old alveolar haemorrhage				

FIGURE 1. Diagrammatic representation of respiratory system, showing sampling sites and areas of old pulmonary haemorrhage.



The histological examination (Fig. 2) revealed extensive bronchiolitis involving the majority of bronchioles in sections from most horses (96%) with little or no mucus production. Most had excess peribronchiolar fibrous connective tissue and an infiltration of lymphocytes and mononuclear cells, sometimes forming a cuff. The alveoli were mostly clear but a few contained old blood as haemosiderin in macrophages. The bronchi were largely unaffected. There was alveolar scarring in some sections which could possibly be related to the resolution of haemorrhage. The histopathology was not identical to chronic obstructive pulmonary disease.

FIGURE 2. Photomicrograph of lungs showing bronchiolitis.



### *Discussion*

The incidence of EIPH after racing at 46.8% is similar to that found by Pascoe *et al.* 1981 (43.8%) but less than that (75.4%) found by Raphael and Soma (1982). However, the latter authors used a longer endoscope (140 cm) and with this discovered that after

racing 25% of Thoroughbred horses had blood only in the distal two-thirds of the trachea. It appears that the incidence of EIPH increases as the examinations penetrate further down the respiratory tract. The amount of blood in the proximal trachea varied markedly in horses that were examined several times. Some horses exhibited considerable haemorrhage on examination, but exhibited less or even no blood at subsequent examinations. This made it impossible to predict future bleeders or indeed to know the extent of haemorrhage in the lungs.

Repeated examinations (more than three) on individual horses demonstrated an 82% incidence, and this is substantiated by the amount of old haemorrhage found at autopsy (82%).

It is interesting that so many of the retired horses from riding schools still had marked areas of old haemorrhage at post-mortem, indicating that lesions take a long time to heal. However, although retired, they were still used as hacks and it is possible, though unlikely, that even this type of exercise can produce EIPH (Sweeney and Soma, 1983).

Having established that almost all horses have had EIPH at some stage, which was severe enough to be demonstrated at post-mortem, we believe that future work should concentrate on its significance and on establishing why it is found in the posterior lobes of the lungs. Raphael and Soma (1982) found that EIPH increased with age and race distance but that it had no effect on performance. The present study found similar results with regard to age but could demonstrate no relationship with distance. In addition, it showed that horses finishing in the first three had less of the serious EIPH. Blood at the nostrils has long been thought to indicate a severe lung haemorrhage, but similar amounts of blood at the proximal trachea can be found in horses that have raced well with or without bleeding. Thus, an animal with serious EIPH at the proximal trachea may not be performing as well as it could, but it is impossible to predict whether it will have serious EIPH or bleed at its next start. The large amounts of blood flowing from the nose coupled with failure to finish in a race are probably the result of the animal bleeding to such an extent that it is unable to breathe and swallow the blood at the same time.

Histological results indicate that nearly all horses have old alveolar haemorrhage, and this raises the question whether EIPH is pathological, physiological or a combination of both.

The extensive bronchiolitis found in this study is unusual in horses but little work has been done elsewhere in Thoroughbred racehorses. It is not yet understood whether it is the cause or the result of the haemorrhage, although Robinson and Derkson (1980) have suggested that bronchiolar obstruction could cause bleeding during maximal exercise. If this is the case, an investigation is needed into the factors contributing to bronchiolitis, e.g. poor stable ventilation and management.

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# Effects of Furosemide on Exercise-Induced Alterations in Haemostasis in Thoroughbred Horses Exhibiting Post-Exercise Epistaxis

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## Summary

*The effect of furosemide on exercise-induced alterations in haemostasis was evaluated in a double blind manner, using ten well trained Thoroughbreds. Post-race epistaxis had been observed in five of the horses at some time in the previous ten days. The other five animals had never displayed epistaxis. All animals were twice galloped over a distance of 1.2 km, four hours after receiving an intravenous injection of furosemide (0.5 mg/kg) or an equal volume of a saline placebo. Blood samples were taken before injection, after saddling and walking each subject to the track, and five minutes after exercise. A number of measurements of blood coagulation and platelet function were made. The most notable finding was that while exercise resulted in a significantly marked reduction of the ADP-induced platelet aggregation wave following placebo injection, the administration of furosemide partially reversed this trend, to the point where the decrease in slope was no longer significant when compared to resting values. This indicated that the platelets from furosemide-treated animals displayed a greater tendency to aggregate post exercise than those of control animals. In the event of any vascular disruption during or after exercise, the platelets from furosemide-treated animals would aggregate and plug the defect faster than those of untreated horses. It was concluded that this finding may provide a basis for the belief that furosemide is of use in the treatment of epistaxis or exercise-induced pulmonary haemorrhage. The mechanism of action of furosemide is unclear at present.*

## Introduction

Exercise-induced pulmonary haemorrhage (EIPH) has been suggested as a more descriptive term for the presence of fresh blood in the trachea or upper respiratory tract of horses, following maximal or near-maximal racing or training (Pascoe *et al.*, 1981). It is observed in Thoroughbred and Standardbred horses and is believed to be relatively