Review of the literature:

Exercise-Induced Pulmonary Haemorrhage (Bleeders): Effect on performance, prevalence, risk factors and treatment

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Prevalence

Blood in the airway is reported to be present in from 40 to 85% of horses following fast strenuous racing. In about half of those affected, it is sufficiently severe that more than half of the tracheobronchial tree is covered. However, pulmonary haemorrhage severe enough to cause epistaxis occurs in only 0.5 to 2.5% of horses following strenuous sprint-type racing. Exercise-induced pulmonary haemorrhage (EIPH) is most commonly reported in horses participating in racing however it is also reported in horses engaged in 3-day events and polo. It is rarely reported in endurance racing. In about 80% of horses affected, it recurs repeatedly during or following race training and competition [1].

Cause

The cause of EIPH is unknown and may differ in different cases. A few of the suggested causes include high blood pressure due to increased cardiac output, hemostatic defects, high blood viscosity secondary to exercise-induced splenic contraction, excessive rate of lung deflation and inherent genetic weakness in the composition of the arterioles [1]. Most believe EIPH occurs secondary to either upper or lower airway obstruction which may be caused by previous damage to the lungs from viral or bacterial respiratory diseases, chronic obstructive pulmonary disease or parasitic migration, Airway obstruction can also occur in horses that have a narrow width between the jaws within the throat latch, laryngeal hemiplegia, tumours, dorsally displaced soft palate and excess flexion of the neck which can cause as much as a 50% reduction in airway passage patency ([2] cited by [1]). It has been reported that the majority of Thoroughbred and Standardbred racehorses have both narrow jaws and some degree of laryngeal hemiplegia, which increases resistance to air movement, impairing performance and predisposing to EIPH ([3] cited by [1]).

Effect on racing performance

A study was conducted on 774 two to 10 year old Thoroughbred horses not medicated with furosemide and not using nasal dilator strips racing in Melbourne, Australia [4]. Horses were enrolled prior to racing and a tracheobronchoscopic examination was performed after one race. Horses with EIPH grades less than 1 were 4.0 times more likely to win a race, 1.8 times more likely to finish the race in the first 3 positions, and 3 times more likely to be in the 90th percentile or higher for race earnings compared to horses with EIPH grades greater than 2. Horses with EIPH grades more than 1 finished significantly farther behind the winner than did horses without EIPH. However, horses with grade 1 EIPH were just as likely to win or finish in the first three positions compared to horses without EIPH. The results of this study confirm that EIPH is associated with impaired performance in Thoroughbred racehorses.

Risk factors – a review of studies

A study was conducted to determine the frequency of epistaxis during or after racing among racehorses and identify factors associated with development of epistaxis [5]. Race start information (breed, age, sex, racing distance, and race type) was obtained for Thoroughbred and Anglo-Arab horses racing in Japan Racing Association-sanctioned races between 1992 and 1997. A total of 247,564 Thoroughbred and 4,045 Anglo-Arab race starts were analysed. All horses that raced were examined by a veterinarian within 30 minutes of the conclusion of the race; any horse that had blood at the nostrils was examined with an endoscope. If blood was observed in the trachea, epistaxis related to EIPH was diagnosed. Epistaxis related to EIPH was identified following 369 race starts (0.15%). Frequency of EIPH-related epistaxis was significantly associated with race type, age, distance, and sex. Epistaxis was more common following: a) steeplechase races than following flat races; b) in older horses than in horses that were 2 years old; c) following races less than or equal to 1,600 m long than following races between 1,601 and 2,000 m long; and d) in females than in sexually intact males. For horses that had an episode of epistaxis, the recurrence rate was 4.64%. The results of this study suggested that frequency of EIPH-related epistaxis in racehorses is associated with the horse's age and sex, the type of race, and the distance raced. The higher frequency in shorter races suggests that higher intensity exercise of shorter duration may increase the probability of EIPH.

A study was also conducted in UK Thoroughbreds to identify risk factors associated with epistaxis [6]. Similar to the Japanese study, risk of epistaxis was significantly increased for hurdle and steeplechase race types compared to both flat and National Hunt flat races. In this study, epistaxis in flat racing was a rare outcome (0.33 cases per 1000 starts) however there did appear to be a significant biological trend for increasing risk of epistaxis with increasing ground hardness ('going') and accumulated years spent racing. Horses with epistaxis were significantly more likely to have a poorer finishing position than those without blood at the nostrils.

In a more recent study conducted in Brazil, the effect of race distance, racetrack surface, going, and season of the year on the recurrence and severity of EIPH and its effect on performance was investigated [7]. Brazil is one of the few countries that have accepted the use of furosemide as a prerace medication for bleeders. 2118 post race respiratory endoscopies were recorded, in a total of 1003 individual horses. All horses in the study were certified bleeders (deemed positive by registered veterinarians following one or more endoscopies) and were administered furosemide prior to each race. Similar to the previously cited papers, the results suggested that race distance, season of the year and racetrack surface affect the recurrence of EIPH. Also, despite the use of furosemide, the majority (62%) of horses continued to display some degree of haemorrhage. There was a tendency for horses that remained positive despite the use of furosemide to finish unplaced in a race. Horses which had a significant reduction in bleeding and became EIPH negative after the use of furosemide, tended to finish in top positions. This study showed there was a tendency towards improvement in performance after administration of furosemide in bleeders however the fact that a large number of horses remained positive for EIPH despite the use of furosemide should encourage researchers to search for better ways of reducing, or preventing, this syndrome.

Researchers in South Africa have also investigated the effect of environmental factors on the incidence of epistaxis related to EIPH [8]. Data was collected over the 1986-2001 period and 778 532 race runs were analysed. Epistaxis on the basis of visible bleeding from the nostrils (endoscopy was not performed) after racing was identified in 1287 horses (0.165%). More horses presented with EIPH-related epistaxis (a) at sea level, (b) from May to October, (c) when older (> 3 years), (d) after 1995, (e) on Fridays and Sundays, and (f) more in geldings than in mares or entire males. No

association could be established between epistaxis and breeder, trainer, distance run, jockey, state of going and weight carried. It was concluded that the frequency of EIPH-related epistaxis was associated with altitude, winter and spring, sex and age. It was also suggested that racing at lower altitudes may increase the probability of exercise-induced pulmonary haemorrhage.

The effect of sex was examined in racing quarter horses [9]. Post race endoscopy was carried out on 255 two-year-old quarter horses and exercise-induced pulmonary haemorrhage (EIPH) was diagnosed in 166 (65 per cent) of them. Visible epistaxis was seen in a higher proportion of geldings than in either mares or stallions. The prevalence of EIPH was similar in mares (73 per cent) and in geldings (74 per cent). A significantly lower prevalence (49 per cent) was noted in stallions (P less than 0.01).

An investigation into the effect of bedding material on the incidence of EIPH in thoroughbreds in Hong Kong was carried out between the 1981 and 1983 racing seasons [10]. A total of 1039 post race endoscopic examinations were performed in 1982-1983 and the results indicated that 46.8 per cent of runners had EIPH. This was not statistically different from the percentage of horses showing EIPH during 1981-82 (46.9 per cent). As it had been postulated that dust, especially from straw, could be implicated in lung haemorrhage a proportion of horses were bedded on paper in the 1982-83 season. No significant differences could be demonstrated in the incidence of EIPH resulting from the use of paper bedding in preference to straw.

To summarise the above papers, common risk factors associated with EIPH were:

- EIPH increases with increasing age
- Intensity of the exercise

Other possible risk factors included:

- Distance – EIPH was more likely to occur in horses racing in shorter distances (less than 1600m)
- Ground hardness – increasing hardness appears to influence EIPH
- Sex – more in geldings than mares/entires
- Season – winter/spring
- Altitude

Treatment of EIPH

Methods of prevention of EIPH were explored in a review by Geor, 2001 [11]. Furosemide is commonly used in the United States and Ontario, Canada to minimize EIPH in horses. In Geor's review he states that studies have shown that on any one day, as many as 70-90% of Thoroughbreds receive furosemide before a race. A lower percentage of Standardbred horses race on furosemide. Geor explains that furosemide works as a diuretic, increasing urine production and decreasing blood volume (and body weight). During exercise, the drug also lowers blood pressure in the lung, probably because of a decrease in blood volume. This should reduce the amount of stress on the pulmonary capillaries, thereby reducing the severity of bleeding. The efficacy of furosemide has been demonstrated in a study where furosemide treatment resulted in a 10-fold reduction in the number of red blood cells in BAL samples obtained 30 minutes after treadmill exercise ([12] cited by [11]). Furosemide did not stop bleeding completely.

Geor further explains that the issue with the use of furosemide in racehorses is whether the drug actually enhances a horse's performance ability independent of any effect on the severity of bleeding. In his article he describes two large-scale research studies which showed that furosemide is associated with superior racing performance ([13, 14] cited by [11]). There are two schools of thought regarding the results. One interpretation is that furosemide does, indeed, improve racing performance, but the change in performance has nothing to do with lung bleeding. Geor continues by saying that another possible conclusion from this work is that because EIPH impairs athletic performance, treatment with furosemide is simply correcting the performance decrease associated with bleeding. Also, because most horses bleed, it can be argued that most should receive furosemide as a pre-race treatment. This article continues by describing punters considering a horse which has received its first treatment on furosemide as a critical factor in handicapping and it has even been suggested that horses treated with furosemide be required to carry extra weight to level the playing field with non-treated horses.

As an alternative to furosemide, a device known as the Flair equine nasal strip has been designed to support the nasal passages and optimize air flow. The initial research findings have been very promising ([12] cited by [11]). Lung bleeding associated with fast treadmill exercise is reduced by 40-45% when horses are equipped with the Flair nasal strip. Given the controversies surrounding the use of any kind of medication in performance horses, the nasal strip is a useful addition to the list of treatments targeted for the management of EIPH.

Numerous nutritional supplements have been tried to prevent EIPH in affected horses. In spite of anecdotal reports of their benefit, in controlled studies the administration of citrus bioflavonoids, vitamins C or K, or inhalation of water-vapour-saturated air, cromolyn or numerous other substances have been found to be ineffective [1]. In one study, EIPH recurred in 84.4% of 45 horses treated with hesperidin-citrus bioflavonoid in their feed for 90 days as compared to 80% recurrence in 40 horses not given the supplement ([15] cited by [1]). Overall respiratory health management is vitally important to minimise further insults to the respiratory tract and anything that might improve ventilation in stables and reduce dust (in bedding and feedstuffs for example by the addition of oil to the diet) may be of benefit.

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