Journal of Equine Veterinary Science 35 (2015) 254–258

Contents lists available at ScienceDirect

Journal of Equine Veterinary Science

journal homepage: www.j-evs.com

Case Report

Loss of Performance in an Endurance Horse With Erythrocytosis and Colic During Exercise

Ana Muñoz [a,b,*], Juan Roldán [a], Pablo Trigo [b], Manuel Gómez-Díez [b], Katy Satué [c], Cristina Castejón-Riber [b]

[a] Department of Animal Medicine and Surgery, School of Veterinary Medicine, University of Córdoba, Córdoba, Spain
[b] Equine Sport Medicine Center, School of Veterinary Medicine, University of Córdoba, Córdoba Spain
[c] Department of Animal Medicine and Surgery, School of Veterinary Medicine, Cardenal Herrera-CEU University, Valencia, Spain

ARTICLE INFO

Article history:
Received 14 September 2014
Received in revised form 3 December 2014
Accepted 9 December 2014
Available online 15 December 2014

Keywords:
Endurance
Erythrocytosis
Exercise
Horse
Performance

ABSTRACT

A 10-year-old endurance horse was presented because of tiredness in training, inability to finish the races, and colic in competition. The horse was continuously supplemented with four different hematinic compounds for more than 8 months. Physical examination showed mild hyperemia, and blood analysis revealed erythrocytosis, increased γ-glutamyl transferase (GGT), and bilirubin with normal total solids (TS) and albumin. Arterial blood gas analysis and ultrasonography were irrelevant. Serum testosterone was within reference range, and increased serum erythropoietin and cobalamin were found. The horse was subjected to a treadmill endurance exercise and after 20 minutes of exercise, blood had a sticky and dark appearance. Exercise was stopped because the horse presented an episode of colic. Packed cell volume (PCV) of 58% and TS of 6.1 g/dL were found at that moment. An inappropriate secondary erythrocytosis because of supplementation was diagnosed. Supplementation was suspended and in the reevaluation 3 months later, PCV reached 49% after 20 minutes of exercise. Bilirubin, GGT, erythropoietin, and cobalamin values were normalized. Seven months later, resting PCV was 36%, and the horse was competing successfully in longer distances. It is concluded that erythrocytosis in an endurance horse might have detrimental effects on performance.

1. Introduction

Many trainers and owners frequently provide supplements to their sport horses to increase red blood cell (RBC) count and hemoglobin (Hb) concentration. It is supposed that higher Hb concentrations would be associated with a greater oxygen transport and utilization during exercise, leading to enhanced aerobic potential and sport performance. In addition, compounds containing iron, cobalamin or vitamin B_{12}, other vitamins, and trace elements associated with iron metabolism are often administered in sport horses to accelerate recuperation of hematological values after anemic situations.

It appears that IV administration of erythropoietin (EPO) might have an ergogenic effect of performance in unfit Standardbred trotters [1]. However, in this research, packed cell volume (PCV) was lower in the EPO-supplemented group than that in the control group. A survey conducted at a California racetrack indicated that a large majority of trainers had their horses on some type of iron supplement [2]. An early study performed in Thoroughbred horses in light training failed to detect q2 changes in PCV or Hb concentration after 8–12 weeks of supplementation [3]. It is known that the risks of over supplementation with trace elements linked to oxygen transport are higher than the likelihood of deficiencies. In fact, overdoses of injectable iron have been shown to cause toxicosis in horses, causing

* Corresponding author at: Ana Muñoz, Department of Animal Medicine and Surgery, Equine Sport Medicine Center, School of Veterinary Medicine, University of Córdoba, Spain.
E-mail address: pv1mujua@uco.es (A. Muñoz).

0737-0806/$ – see front matter © 2015 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jevs.2014.12.015

liver damage and cholestasis [4]. However, a more recent experimental study found that PO administration of ferrous sulfate during 8 weeks did not produce adverse clinical reactions or liver histologic lesions in four ponies [5]. Cobalt ions (Co^{2+}) could induce EPO gene expression in human begins, leading to erythrocytosis [6].

We present here a case of an endurance horse with erythrocytosis, loss of performance, and colic during exercise that improved when long-term supplementation (more than 32 weeks) was stopped.

2. Case Description

2.1. History

A 10-year-old gelding well-trained Anglo-Arabian horse was referred to the Equine Sport Medicine Center of the College of Veterinary Medicine of Córdoba because of the loss of performance. The owner reported that the horse appeared tired during the training sessions. In addition, he was unable to finish the last four 80-km endurance races where he competed. In all the cases, the horse was disqualified with marked dehydration, hyperemic mucous membranes, and paralytic ileus. In the last endurance event, the horse presented mild-to-moderate colic episodes and rhabdomyolysis that disappeared when exercise was suspended and medical intervention was not required. Five months before remission, the horse had been competing successfully in the same distance (80 km). The trainer informed that the horse had been receiving continuously vitamin B_{12} and iron supplementation for at least the last 8 months (Biodyl, Methio B12, Hemo 15, and Hippiron). Diet of the horse consisted in a concentrate source and fodder of good quality combined with pasture.

2.2. Clinical Examination

Physical examination at admission was irrelevant with exception of hyperemia in the mucous membranes. Auscultation of the thorax and abdomen did not reveal abnormal findings.

2.3. Laboratory Findings

Blood analysis showed increased PCV (48%; reference values for endurance horses, 35%–38% [7]). Total solids (TS, 6.6 g/dL; reference values for endurance horses, 6.47 ± 0.85 g/dL [7]) and albumin concentrations (2.8 g/dL; reference values for endurance horses, 2.66–2.80 g/dL [7]) were normal. To rule out stress and splenic contraction as a cause of the increased PCV, the horse was kept calm in a box, and three blood samples were withdrawn every hour. Packed cell volume values higher than 46% were found in the three samples. Increased total bilirubin (3 mg/dL; reference values, 0.5–2.2 mg/dL [8]) and γ-glutamyl transferase (GGT, 89 IU/L; reference values, 6.5–24.5 IU/L [8]) were also found. Serum iron (111 μg/L; reference values, 132–186 μg/L [9]) and ferritin (30.1 μg/L) concentrations were within reference limits for horses (ferritin: 31.9 ± 3.4 μg/L) [10]. Serum creatine kinase (CK), aspartate aminotransferase (AST), and lactate dehydrogenase (LDH) activities were 208, 183, and 375 IU/L, respectively (reference values: CK, 155.2 ± 18.43 IU/L; AST, 195.1 ± 18.40 IU/L; LDH, 346.0 ± 37.85 IU/L) [7].

2.4. Further Diagnostic Procedures

Diagnostic workout included arterial blood gas analysis, thorax, and abdominal ultrasonography, including echocardiography, measurements of serum testosterone, EPO and vitamin B_{12} concentrations, and endurance treadmill exercise testing.

Results of arterial blood gas analysis were within normal limits for horses: PaO_2, 93 mm Hg (73–108 mm Hg); O_2 saturation, 98% (>94%); pH 7.402 (7.364–7.444); $PaCO_2$, 45 mm Hg (34–50 mm Hg); and bicarbonate, 25 mmol/L (20–34 mmol/L) (VetStat; Idexx). Ultrasonographic findings in thorax and abdomen were unremarkable. Serum testosterone concentration was measured with a competitive enzyme immunoassay validated for horses [11]. A serum testosterone concentration of 6.89 pg/mL was found (35.48 ± 10.89 pg/mL for geldings). Serum EPO concentrations were measured with a chemiluminescent immunometric assay developed for humans (Immulite; Siemens). A value of 3.6 mIU/L was measured. Four age-matched healthy endurance horses were considered controls, and all of them had concentrations lower than 0.6 mIU/L (0.424 ± 0.114 IU/L). Increased serum vitamin B_{12} concentrations were found (3,000 pg/mL; reference range provided by the laboratory, 700–1700 pg/mL).

To assess the adaptation to exercise, the horse was subjected to an endurance treadmill exercise. Environmental temperature was 19°C, and relative humidity was 44%. After 10 minutes of warm-up period (5 minutes at walk and 5 minutes at trot), the treadmill was inclined 3%, and velocity was increased until a stable heart rate of 110–130 beats/min was achieved (6 m/s). Blood samples were taken during exercise every 10 minutes. Values of PCV and TS are presented in Table 1. After 20 minutes of exercise, during blood sampling, it was observed that blood was very sticky. Exercise was interrupted at that moment because the horse started to show colic. Intestinal peristaltism was intensely reduced. Colic signs disappeared after 15 minutes without medical treatment and after the horse drank 5 L of water. Recovery of heart rate (64 beats/min at 7 minutes after exercise) and respiratory rate (120 breaths/min at 5 minutes after exercise) was poor for a well-trained endurance

Table 1
Packed cell volume (PCV) and total solids (TS) during an endurance treadmill exercise in a horse with secondary erythrocytosis, at admission and 3 months later, after interrupting supplementations.

Sampling Times	PCV (%)	TS (g/dL)
Exercise test at admission		
At rest	48	5.6
After 10 min of endurance treadmill exercise	54	6.1
After 20 min of endurance treadmill exercise	58	6.1
Exercise test three months later		
At rest	43	7.0
After 10 min of endurance treadmill exercise	48	7.8
After 20 min of endurance treadmill exercise	49	8.0