Short Communications

Blood gas analysis in a Spanish sighthound breed (galgo Español)

S. Zaldívar-López, R. Ruano-Barneda, G. Couto

GREYHOUNDS have numerous haematological and serum biochemical parameters that differ from those in other breeds of dog (Porter and Canaday 1971, Shiel and others 2007). Blood gases and acid-base balance have been of special interest in racing greyhounds, as part of studies of their exercise physiology. Those studies demonstrated that racing greyhounds experience extreme changes during a race (Ilkiw and others 1989, Rose and Bloomberg 1989, Nold and others 1991) that are even more pronounced than in other sporting species, such as horses and human beings (Nold and others 1991). These parameters have also been studied in healthy non-racing greyhounds (Porter and Canaday 1971, Shiel and others 2007), and several breed-specific peculiarities have been confirmed. Other sighthound breeds, such as the saluki, Afghan hound and whippet, have been reported to have clinicopathological peculiarities as well (Hilppö 1986, Shiel and others 2010).

The galgo Español (Spanish greyhound) is closely related to the greyhound. The Fédération Cynologique Internationale classifies both the galgo Español and the greyhound in group 10 (sighthounds), section 3 (short-haired sighthounds). The galgo is also a sporting breed, although its athletic performance and purpose differ from the greyhound (galgos are mainly used for hunting hares and lure coursing instead of sprint racing). Due to the similarities and common origins of the galgo and the greyhound, the authors hypothesised that blood gas parameters in galgos would be similar to those of the greyhound and differ from those in other, non-racing breeds of dog.

This study aimed to determine the normal haematological and biochemical values in the galgo Español and to compare the results of venous blood gas analysis in a group of galgos and a group of mixed-breed dogs.

Venous whole blood samples were collected from 20 galgos and 17 mixed-breed dogs. All the galgos and seven of the mixed-breed dogs were at a shelter at the time of the study (Scooby Medina, Medina del Campo, Valladolid, Spain); the other 10 mixed-breed dogs were patients at a private veterinary practice in Madrid, geographically close to the shelter. All the dogs were considered to be healthy on the basis of a physical examination. The ages of the dogs ranged from one to seven years, and males and females were equally represented. At the time of sampling, all the galgos were neutered and all the mixed-breed dogs were entire. Signed consent was obtained from the director of the shelter and from the owners of the dogs recruited at the veterinary practice. Samples were obtained by venepuncture of the cephalic vein, using a 2 ml plastic syringe and a 23 G needle, and blood was placed immediately into a 1 ml heparinised tube. All samples were analysed by the same operator (RR-B) immediately after collection, using the VetStat Electrolyte and Blood Gas Analyzer with respiratory/blood gases cassettes (IDEXX Laboratories). The parameters measured are listed in Table 1. The P_{50} value (partial pressure of oxygen at which the haemoglobin [Hb] molecule is 50 per cent saturated) was calculated in order to assess the Hb oxygen affinity. The data were analysed using the statistical software GraphPad Prism (GraphPad Software).

For comparison purposes, the dogs were divided into two groups: galgos and mixed-breed dogs. Descriptive statistics and a normality test (Kolmogorov-Smirnov test) were performed. Both groups were compared statistically using a *t* test or Mann-Whitney test, depending on the distribution of the data. Statistical significance was accepted at $P<0.05$.

From the 17 parameters measured by the analyser, 11 showed statistically significant differences between the groups of dogs. Blood samples from galgos had higher bicarbonate concentration (HCO_3^-, $P<0.0001$), pCO_2 ($P=0.0002$) and total carbon dioxide (tCO_2, $P=0.0002$) than those from the mixed-breed dogs; galgos also had higher total Hb content (tHb, $P<0.0001$) and oxygen content (O_2Ct, $P=0.0005$). In contrast, the blood samples from galgos had lower pH ($P=0.0386$), chloride concentration (Cl, $P=0.0123$) and P_{50} ($P=0.0013$) than the mixed-breed group (Table 1). Fig 1 shows the most relevant parameters.

The most relevant results among the galgos were the higher pCO_2 and tHb, since HCO_3^- and tCO_2 are calculated using PCO_2, and O_2Ct is calculated using tHb. The high Hb concentration and oxygen capacity are consistent with the results of a previous study in retired racing greyhounds (Zaldívar-López and others 2011), and would provide more efficient oxygen transport.

TABLE 1: Mean (sd) values of parameters directly measured by a point-of-care blood gas analyser, and calculated P_{50}, in 20 galgo Español dogs and 17 mixed-breed dogs

Parameter	Galgo	Mixed-breed	P
pH	7.39 (0.033)	7.43 (0.067)	0.0386
HCO_3^- (mmol/l)	26.61 (2.25)	23.06 (2.24)	<0.0001
pCO_2 (mmHg)	47.85 (6.52)	38.29 (7.24)	0.0002
AnGap (mmol/l)	22.47 (2.23)	23.01 (2.53)	NS
BE (mmol/l)	0.89 (1.22)	−0.094 (2.31)	NS
BEecf (mmol/l)	1.93 (1.95)	−0.85 (2.24)	0.0003
BEact (mmol/l)	0.47 (1.50)	−0.95 (2.41)	0.0359
BB (mmol/l)	50.9 (1.57)	39.7-51.0*	0.0005
tCO_2 (mmol/l)	28.08 (2.42)	24.22 (2.36)	<0.0001
cH^+ (mmol/l)	40.81 (3.16)	32.5-60.5*	0.01
pO_2 (mmHg)	49.74 (18.5)	47.53 (10.13)	NS
tHb (g/dl)	20.05 (1.89)	16.02 (2.29)	<0.0001
sO_2 (%)	77.05 (11.65)	78.06 (8.41)	NS
O_2Ct (vol%)	21.5 (3.23)	17.59 (2.91)	0.0005
Na (mmol/l)	157 (2.28)	155.9 (2.32)	NS
K (mmol/l)	4.40 (0.24)	4.63 (0.44)	NS
Cl (mmol/l)	112.4 (2.09)	114.5 (2.68)	0.0123
P_{50} (mmHg)	27.78 (1.19)	29.14 (0.97)	0.0013

* Data not normally distributed, expressed as observed ranges
AnGap Anion gap, BB Buffer base, BE Base excess, BEact Actual base excess, BEecf Base excess in extracellular fluid, cH^+ Hydrogen ion concentration, Cl Chloride, HCO_3^- Bicarbonate, K Potassium, Na Sodium, NS Difference not significant, O_2Ct Oxygen content, P_{50} Partial pressure of oxygen at which the haemoglobin molecule is 50 per cent saturated, sO_2 Oxygen saturation, tCO_2 Total carbon dioxide

Veterinary Record doi: 10.1136/vr.c6877

S. Zaldívar-López, DVM, MS,
G. Couto, DVM, DACVIM,
Department of Veterinary Clinical Sciences, Ohio State University, 601 Vernon L. Tharp Street, Columbus, OH 43210, USA
R. Ruano-Barneda, DVM,
Centro Veterinario Mediterráneo, Avenida Mediterráneo 14, Madrid 28007, Spain

Dr Zaldívar-López is also at the Research Institute at Nationwide Children's Hospital, 700 Children's Drive, Columbus, OH 43205, USA

Dr Couto is also at the OSU Comprehensive Cancer Center, Ohio State University, 300 West 10th Avenue, Columbus, OH 43210, USA

E-mail for correspondence: sara.zaldiv@gmail.com

Provenance: not commissioned; externally peer reviewed

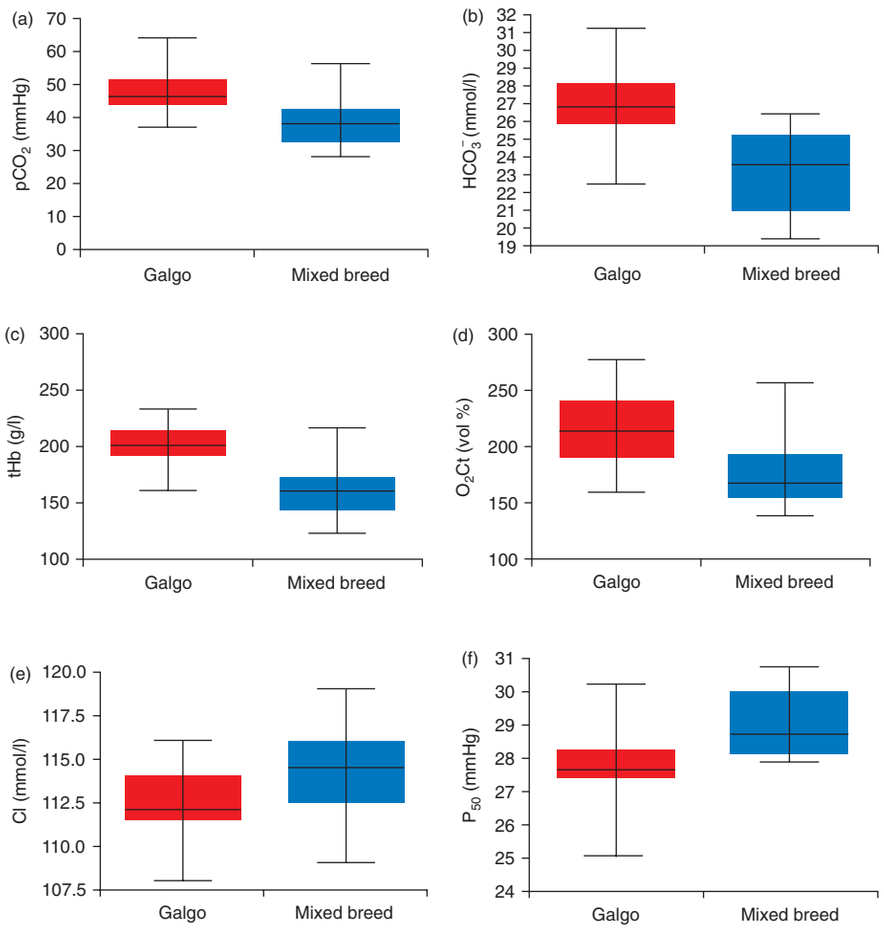

FIG 1: Graphs showing some of the most relevant parameters where statistically significant differences were found between a group of galgo Español dogs and a group of mixed-breed dogs. (a) pCO_2, (b) bicarbonate concentration (HCO_3^-), (c) haemoglobin concentration (tHb), (d) oxygen content (O_2Ct), (e) chloride concentration (Cl), (f) pO_2 when haemoglobin is 50 per cent saturated (P_{50})

The P_{50}, which has been previously reported to be lower in retired racing greyhounds than in non-greyhound breeds, was also lower in the galgos. It was previously thought that higher oxygen affinity (low P_{50}) is counterproductive for exercise, since the oxygen remains bound to the Hb molecule for longer and thus is not easily released to the tissues (Dimino and Palmer 2007). This paradigm has changed with the development of artificial blood substitutes, with studies demonstrating that low P_{50} Hb targets oxygen to hypoxic tissues (Winslow 2005). In the present study, lower P_{50} values were documented among the group of galgos, which suggests that this feature could be class-specific to sighthounds.

Blood gas, acid-base and electrolyte balance are commonly evaluated in daily veterinary clinical practice, and the knowledge of breed-related peculiarities is essential in order to establish adequate and individualised therapies in dogs.

Acknowledgements

The authors thank IDEXX Laboratories Spain for their support in this study, providing the blood gas and respiratory cassettes and reagents needed for the measurement of the parameters. This work was supported in part by Caja Madrid Scholarship Program, Fundación Caja Madrid, Madrid, Spain (SZ-L), and IDEXX Laboratories (Spain).

References

DIMINO, M. L. & PALMER, A. F. (2007) Hemoglobin-based O_2 carrier O_2 affinity and capillary inlet pO_2 are important factors that influence O_2 transport in a capillary. *Biotechnology Progress* **23,** 921-931

HILPPÖ, M. (1986) Some haematological and clinical-chemical parameters of sight hounds (Afghan hound, saluki and whippet). *Nordisk Veterinaermedicin* **38,** 148-155

ILKIW, J. E., DAVIS, P. E. & CHURCH, D. B. (1989) Hematologic, biochemical, blood-gas, and acid-base values in greyhounds before and after exercise. *American Journal of Veterinary Research* **50,** 583-586

NOLD, J. L., PETERSON, L. J. & FEDDE, M. R. (1991) Physiological changes in the running greyhound (*Canis domesticus*): influence of race length. *Comparative Biochemistry and Physiology. A, Comparative Physiology* **100,** 623-627

PORTER, J. A., Jr & CANADAY, W. R., Jr (1971) Hematologic values in mongrel and greyhound dogs being screened for research use. *Journal of the American Veterinary Medical Association* **159,** 1603-1606

ROSE, R. J. & BLOOMBERG, M. S. (1989) Responses to sprint exercise in the greyhound: effects on haematology, serum biochemistry and muscle metabolites. *Research in Veterinary Science* **47,** 212-218

SHIEL, R. E., BRENNAN, S. E., O'ROURKE, L. G., MCCULLOUGH, M. & MOONEY, C. T. (2007) Hematologic values in young pretraining healthy greyhounds. *Veterinary Clinical Pathology* **36,** 274-277

SHIEL, R. E., SIST, M., NACHREINER, R. F., EHRLICH, C. P. & MOONEY, C. T. (2010) Assessment of criteria used by veterinary practitioners to diagnose hypothyroidism in sighthounds and investigation of serum thyroid hormone concentrations in healthy salukis. *Journal of the American Veterinary Medical Association* **236,** 302-308

WINSLOW, R. M. (2005) Targeted O_2 delivery by low-p50 hemoglobin: a new basis for hemoglobin-based oxygen carriers. *Artificial Cells, Blood Substitutes, and Immobilization Biotechnology* **33,** 1-12

ZALDÍVAR-LÓPEZ, S., CHISNELL, H. K., COUTO, C. G., WESTENDORF-STINGLE, N., MARIN, L., IAZBIK, M. C., COOPER, E. S., WELLMAN, M. L. & MUIR, W. W. III (2011) Blood gas analysis and cooximetry in retired racing greyhounds. *Journal of Veterinary Emergency and Critical Care* **21,** 24-28

Blood gas analysis in a Spanish sighthound breed (galgo Español)

S. Zaldívar-López, R. Ruano-Barneda and G. Couto

Veterinary Record published online March 17, 2011
doi: 10.1136/vr.c6877