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GAS EXCHANGE AND ACID BALANCE DISORDERS IN FRENCH BULLDOGS

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Key words: *brachycephalic syndrome, acid-base balance*

Introduction

Brachycephalic syndrome develops as a result of a specific build of splanchnocranium and it often occurs in French bulldogs and other brachycephalic breeds (boxers, bulldogs, Pekingeses, shi-tzu, and Boston terriers) likewise (Hendricks 1992). In dogs of these breeds, an impairment of correct gas exchange occurs i.e. a volume of the inhaled and exhaled air is significantly lower compared to the dogs of other breeds due to anatomic obstacles in the upper airways such as nostril stenosis, central dislocation of the external nostrils cartilaginous structure, nasal canal stenosis, lengthened soft palate, everted laryngeal pouches, laryngeal collapse and tracheal hypoplasia, which occurs in English bulldogs ([Amis and Kurpershoek](#) 1986). Inspiratory dyspnoea dominates and is accompanied by wheezing, snoring, whistling rales, lowered effort tolerance, and, in more difficult cases, cyanosis and collapse (Wykes 1991).

Aim of the study

Aim of the study was to determine whether gas exchange disorders cause changes in parameters of acid-base balance and partial pressure of Oxygen (pO_2) in French bulldogs.

Materials and Methods

5 French bulldogs at the age of 11 - 14 months, which suffered from continuous mixed-type dispnoea and lowered effort tolerance. Their owners also reported episodes of apnoea, which occurred the most often at night, short-lived consciousness disturbances as well as wheezing, snoring, and whistling rales. Apart from the above-mentioned symptoms, the occurrence of strong external nostril stenosis was noted in the clinical examination. The symptoms observed together with the nostril stenosis indicated a possibility of an occurrence of the brachycephalic syndrome. 1 ml of full blood was drawn from the femoral artery to a heparinized syringe equipped with a needle with an internal diameter of 0.7 mm. Acid-base balance parameters were determined in the arterial blood: pH, partial pressure of CO_2 (pCO_2), concentration of bicarbonates (HCO_3^-), and partial pressure of Oxygen (pO_2). The blood was passed on to the analytical laboratory immediately after its drawing.

Results and Discussion

The obtained values of the morphologic and biochemical examination were within the limits of reference values. The results of the blood gasometry clearly indicate an occurrence of respiratory acidosis, i.e. such a kind of the acid-base balance disorder in which an original increase of $p\text{CO}_2$ – carbonic acid anhydride takes place (table 1). In the case of respiratory acidosis, the organism, aiming at the pH normalization, stimulates kidneys for regeneration of HCO_3^- and expelling of H^+ (Constable 2000, Di Bartola 2006). This interpretation is in accordance with the classic description of the acid-base balance on the basis of the Henderson-Hasselbach equation, where the blood pH is the resultant of the metabolic component expressed by bicarbonate (HCO_3^-) concentration and the respiratory component or the pressure of carbon dioxide ($p\text{CO}_2$) (Di Bartola 2006).

$$\text{pH} = 6.11 + \log \frac{[\text{HCO}_3^-]}{p\text{CO}_2 \times 0.226}$$

In the cases discussed, the chronic respiratory acidosis can be noticed, in which an increase of $p\text{CO}_2$ by each 1 mmHg is accompanied by a compensatory increase of HCO_3^- concentration by 0.35 mEq/L, or more (De Morais and DiBartola 1991). In people with the chronic respiratory acidosis, an increase of $p\text{CO}_2$ by each 1 mmHg is accompanied by an increase of HCO_3^- concentration by 0.51 mEq/L (Martinu et al. 2003), which, as it results from the research conducted by Alfaro et al. (Alfaro et al. 1996), is sufficient for normalization of the blood pH in the course of the disorder. On the basis of the obtained results, it was calculated that, in the cases presented, each increase of $p\text{CO}_2$ by 1 mmHg was accompanied by a compensatory increase of HCO_3^- by 0.61 mEq/L on average. Observed consciousness disorders could be result of significantly lower partial pressure of Oxygen in investigated bulldogs in comparison to reference parameters.

Conclusions

The results we achieved suggest that in brachycephalic breeds the blood gasometry and partial pressure of Oxygen is the important element of diagnostics. There is the need of farther investigation of the results of the wing-of-the-nostrils and soft palate correction procedure on the change of the acid-base balance parameters and possible use of THAM in respiratory acidosis treatment, as in human medicine.

Reference

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Table 1.

The comparison between the reference pO₂ and acid-base balance parameters values and results of the study

	Reference values*	Investigation results
pH	7.35 – 7.46	7.41
pCO ₂ mmHg (kPa)	30.8 – 42.8 (4 – 5.56)	52.0 (6.76)
HCO ₃ ⁻ mmol/L	18.8 – 25.6	32.20
pO ₂ mmHg (kPa)	80.9 – 103.3 (10.51 - 13.42)	73.0 (9.49)

* Di Bartola S.P. Fluid, electrolyte and acid base disorders in small animal practice. Saunders Elsevier 2006 St Louis

Summary

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