

Ionized calcium as a prognostic parameter in colic horses.

C. Delesalle, J. Dewulf, JAJ. Schuurkes, B. Van Vlierbergen, H. Nollet, D. Declerq, P. Deprez

Department of Large Animal Internal Medicine, Faculty of Veterinary Medicine, Ghent University, Salisburylaan 133, B-9820 Merelbeke, Belgium (Delesalle, Dewulf, Van Vlierbergen, Nollet, Declerq, Deprez); Johnson & Johnson Pharmaceutical Research and Development, a division of Janssen Pharmaceutical N.V., Turnhoutseweg 30, B-2340 Beerse, Belgium (Schuurkes).

Hypocalcemia is a common finding in horses with severe gastrointestinal disorders.^{1,2,3} Since ionized Ca^{2+} is the biological active form, determination of its levels is more relevant than determination of total calcium¹. The aims of the study were to find relations between hypocalcemia and other parameters determined in colic horses at the moment of entrance in the clinic. Furthermore, the relation between hypocalcemia and the development of ileus during hospitalisation and the short term survival, was examined. Finally the influence of the correction of low blood ionized calcium levels on the clinical outcome was evaluated.

In 144 horses with acute abdominal crisis, the packed cell volume (PCV), base excess (BE), blood pH, serum sodium, potassium, and whole blood ionized Ca^{2+} concentrations, heart rate and amount of reflux were determined at the time of admission at the Clinic of Large Animal Internal Medicine, Ghent University. Patient material consisted of 62 horses with small intestinal associated colic, 53 horses with large intestinal associated colic, 17 horses with

gastroduodenitis and 12 horses with undetermined digestive colic. Horses were denoted as endotoxemic if the following three criteria were fulfilled: heart rate > 60 bpm, PCV > 50%, capillary refill time > 3 secs.

Correction of low blood calcium was randomly performed. Whenever a surgical intervention was needed, Ca²⁺ substitution was postponed until after recovery. Correction of hypovolemia and acid-base imbalances was realised as much as possible before administration of Ca²⁺, in order to reduce possible promotion of cell death and tissue damage⁴. When Ca²⁺ substitution was performed, blood ionized Ca²⁺ levels were monitored and repetitive correction was performed whenever necessary. Correction was performed by slow intravenous administration of 400 mEq Ca²⁺ (Calcii-Borogluconas[®], Eurovet, Belgium) diluted in 10L of a Ringer's lactate solution. Venous blood samples were collected anaerobically from the jugular vein in a tube containing lithium heparin. Na⁺, K⁺, Ca²⁺ levels were determined by use of an ion-selective electrode (AVL 9180, AVL Scientific Corporation, Roswell, GA, USA).

In a preliminary experiment the whole blood ionized Ca²⁺ concentration and corresponding pH was determined in 25 healthy horses. By means of the multiple regression equation that was proposed by Van der Kolk and co-workers, these ionized Ca²⁺ levels were adjusted to pH=7.4.⁵ On the basis of these data a normal range of 1.61-1.85 mmol/l (expressed as mean ± 2 s.d.) was used as reference range.

88% of all colic patients showed blood ionized Ca²⁺ levels below the reference range at the time of admission. Mean ionized Ca²⁺ levels in horses with small intestinal colic (1.36 ± 0.28 mmol/l) and horses suffering from gastroduodenitis (1.33 ± 0.14 mmol/l) were lower than in horses with large intestinal colic (1.47 ± 0.19 mmol/l) and undetermined digestive colic (1.42 ± 0.24 mmol/l). Horses with signs of endotoxemia tended to have very low blood ionized calcium levels (1.28 ± 0.28 mmol/l).

Univariate linear regression analysis revealed that presence of reflux ($p < 0.001$) or endotoxemia ($p < 0.001$), pH ($p < 0.001$), BE ($p < 0.001$), PCV ($p < 0.001$) and heart rate ($p < 0.001$), were all significantly related with the blood ionized Ca^{2+} level at the time of admission, whereas gender, breed, duration of colic before admission, age, and gestation were not significantly related with the Ca^{2+} levels.

In the multivariate analysis the presence of reflux at arrival, PCV, pH and the interaction PCV/pH remained significant.

Using a multivariate logistic regression it was found that for every decrease of the blood ionized Ca^{2+} level with 0.1 mmol/l, the odds ratio (OR) for developing ileus during hospital stay became 1.95 (1.26-3.03) times larger. This indicates that Ca^{2+} levels are clearly associated with the probability of developing ileus. Also the presence of reflux at arrival (OR=21.86) and the presence of septicemia/toxaemia (OR=5.53) are significantly related with the probability of developing ileus during the hospitalisation period.

Low Ca^{2+} levels are also significantly associated with the probability of poor outcome. For every increase of the Ca^{2+} level with 0.1 mmol/l the odds ratio of short term survival increases with 1.43 (1.22-1.70).

Additionally, in the multivariable logistic regression model, it was shown that the ionized calcium level (OR=1.45); the presence of septicemia/toxaemia at the time of arrival (OR=6.74) and the number of Ca^{2+} corrections were all significantly associated with the probability of short term survival. It was shown that the probability of survival increases significantly when normalization of Ca^{2+} levels could be obtained with one correction (OR=3.98 (3.44-10.99)). When multiple corrections were needed, the probability of survival decreased, although this decrease was not statistically significant. (OR=0.79(0.26-2.38)).

This study shows the importance of measuring ionized calcium levels in colic horses.

It can be used in the assessment of short term survival prognosis and correction of hypocalcemia seems to improve clinical outcome. The need for repeated corrections however can be regarded as a poor prognostic indicator.

References

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